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PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XIX. Nos. 259–273.

JANUARY—DECEMBER, 1903.

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LONDON
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LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to J. B. Cohen, to continue the study of bromo- and chlorotoluenes and their derivatives.

£5 to J. McCrae, to investigate the optical activity of derivatives of active *sec.*-butylamine.

£10 to J. J. Sudborough, to continue his research on steric hindrance; and derivatives of trinitrobenzene.

£15 to R. S. Morrell and J. M. Crofts, to continue their investigation of the action of hydrogen peroxide on carbohydrates in the presence of ferrous sulphate.

£25 to J. N. Collie, to investigate the production of mixed tertiary phosphines and phosphonium bases; and the preparation of condensation products from the sodium derivative of diacetylacetone.

£12 to T. S. Patterson, to continue his research on the optical activity of compounds in solution.

£15 to A. Lapworth, to investigate some $\alpha\beta$-unsaturated ketones, acids, and allied substances.

£10 to A. W. Harvey, to investigate some asymmetric substituted ammonium compounds.

£25 to F. Soddy, to investigate the spectrum of radium emanation, and the nature of the α projected particle, and the ultimate products of the disintegration of radium.

£10 to J. Wade, to continue his investigation of the cyanogen compounds as bearing on the mechanism of the interchange of radicles.

£5 to H. A. Auden, to investigate the experiments on heterocyclic ring syntheses.

£10 to J. C. Cain, to continue his research on the action of water on *o*-substituted diazonium salts.

£10 to F. G. Donnan, to investigate the reaction between the alkyl iodides and silver nitrate in alcoholic solution.

£10 to G. D. Lander, to investigate the imino-ethers and allied compounds.

£10 to B. Prentice, to investigate the constitution of 1 : 5-pyrazolidone compounds.

£10 to A. Slator, to investigate the reactions between sodium thiosulphate and organic chlorides, bromides, and iodides.

£10 to S. Smiles, to investigate the optical activity of some sulphur compounds.

£25 to B. D. Steele, to investigate the conductivity of solutions of substances in liquefied gases.

£10 to J. J. Sudborough, to investigate the esterification constants of organic acids.

LIST OF FELLOWS ELECTED DURING 1903.

Name.	Proposed.	Elected.
Abell, Robert Duncombe	November 5th, 1903	December 3rd.
Adshead, Henry Guest	March 5th, 1903	April 22nd.
Alderton, Gilbert John	November 19th, 1902.	February 18th.
Alton, William Lester St. John	March 18th, 1903	April 22nd.
Appleyard, George Henry	January 21st, 1903	February 18th.
Appleyard, Percy	November 5th, 1903	December 3rd.
Armstrong, Edward Frankland	,, ,,	,, ,,
Ashdown, Herbert Henry	,, ,,	,, ,,
Atkinson, Edwin Bayles	December 17th, 1902.	February 18th.
Atkinson, Harford Montgomery	March 5th, 1903	April 22nd.
Attwell, Herbert Moore	November 5th, 1903	December 3rd.
Aubrey, Henry James	April 22nd, 1903	June 17th.
Badcock, William Cornish	November 5th, 1903	December 3rd.
Bailey, Harold James	,, ,,	,, ,,
Barger, George	April 22nd, 1903	June 17th.
Barker, Thomas Vipond	November 5th, 1903	December 3rd.
Bayly, Harold Goodenough	,, ,,	,, ,,
Beadnell, Charles Marsh	,, ,,	,, ,,
Beam, William	,, ,,	,, ,,
Bennett, Colin Noël	May 20th, 1903	June 17th.
Beveridge, Wilfrid William Ogilvy	June 4th, 1903	,, ,,
Bhaduri, K.	December 17th, 1902.	February 18th.
Bibby, Charles Drake	April 22nd, 1903	June 17th.
Bibby, R. Gordon	February 18th, 1903	April 22nd.
Blackshaw, George Neville	March 5th, 1903	,, ,,
Bliss, Henry James Wheeler	November 5th, 1903.	December 3rd.
Bluman, Nicholas John	,, ,,	,, ,,
Bowen, William	December 17th, 1902.	February 18th.
Bradbury, Samuel	January 21st, 1903	,, ,,
Branch, George Thomas	,, ,,	,, ,,
Brennand, Henry John Wolverton	April 22nd, 1903	June 17th.
Brühl, Paul	November 5th, 1903	December 3rd.
Buggé, Erasmus Robert	,, ,,	,, ,,
Burghard, William Godsell	April 2nd, 1903	June 17th.
Bury, Ernest	May 7th, 1903	,, ,,
Bywaters, Hubert William	January 21st, 1903	February 18th.
Cadman, William Henry	January 21st, 1903	February 18th.
Calvert, Harry Thornton	March 5th, 1903	April 22nd.
Campbell, Thomas	May 7th, 1903	June 17th.
Carrier, Albert James	,, ,,	,, ,,
Castell-Evans, John	January 21st, 1903	February 18th.
Caudwell, Ben	March, 5th, 1903	April 22nd.
Clacher, William	November 5th, 1903	December 3rd.
Codling, Arthur John	January 21st, 1903	February 18th.
Cousins, Francis George	December 4th, 1902	,, ,,
Coyle, Benjamin Claxton	January 21st, 1903	,, ,,

Name.	Proposed.	Elected.
Deeks, William Thomas	November 5th, 1903.	December 3rd.
Derwent, Ernest	June 4th, 1903	,, ,,
Desch, Cecil Henry	January 21st, 1903 ...	February 18th.
Divine, Thomas	February 18th, 1903.	April 22nd.
Eastwood, Arthur William	February 5th, 1903...	April 22nd.
Edgerton, John Percy	February 5th, 1903...	,, ,,
Elford, Archibald Sefton	December 4th, 1902..	February 18th
Ellis, Henry Russel	November 5th, 1903. .	December 3rd.
Fairhall, Edwin Jesse	April 2nd, 1903	June 17th.
Farmer, Robert Crosbie	December 17th, 1902.	February 18th.
Fawsitt, Charles Edward	November 5th, 1903..	December 3rd.
Fletcher, Alan	March 5th, 1903	April 22nd.
Forster, William	June 4th, 1903	December 3rd.
Friend, John Albert Newton	November 5th, 1903..	,, ,,
Candy, William Hunter	May 20th, 1903	June 17th.
Gardiner, Ernest Alexander	November 5th, 1903. .	December 3rd.
Gatehouse, Frank Brooks	,, ,,	,, ,,
Gent, Percy William	June 17th, 1903	,, ,,
Gough, Henry	March 18th, 1903	April 22nd.
Grundy, Frank Barnes	November 5th, 1903. .	December 3rd.
Hall, John T.	November 5th, 1903. .	December 3rd.
Harmer, Francis Gerald	May 7th, 1903	June 17th.
Heasman, Harold Montague	November 5th, 1903. .	December 3rd.
Hendrickson, Arthur V.	,, ,,	,, ,,
Hindmarsh, Leonard King	January 21st, 1903 ...	February 18th.
Howarth, John George	November 5th, 1903. .	December 3rd.
Howorth, Franklin Wise	January 21st, 1903 ...	February 18th.
Howsam, George	February 5th, 1903...	April 22nd.
Hughes, Edwin Reginald	June 4th, 1903	December 3rd.
Huyin, Moung Tha	December 4th, 1902..	February 18th.
Hymans, Herbert	November 5th, 1903. .	December 3rd.
Ibbotson, Edward Charles	November 5th, 1903. .	December 3rd.
Jackson, William Henry	November 5th, 1903..	December 3rd.
Jennings, Walter Ernest	June 4th, 190	,, ,,
Jones, Alfred Owen	February 5th, 1903...	April 22nd.
Kemp-Welch, Maurice	December 4th, 1902..	February 18th.
Kent, Thomas Oliver	November 5th, 1903. .	December 3rd.
Kerr, James Stewart	February 5th, 1903 ...	April 22nd.
Kielty, John J.	November 5th, 1903..	December 3rd.
Kin, Thein	June 4th, 1903	,, ,,
King, Frank William George	May 7th, 1903	June 17th.
Kirkby, William	March 18th, 1903	April 22nd.
Knight, Harley Fancutt	November 5th, 1903. .	December 3rd.
Laing, John	November 5th, 1903..	December 3rd.
Lamplough, Francis Edward Everard	November 5th, 1903. .	,, ,,
Lawrence, Henry William	June 17th, 1903	,, ,,
Leadbetter, Harold Duff	November 5th, 1903. .	,, ,,
Le Bas, Gervaise	,, ,,	,, ,,
Lees, Frederick Herbert	December 17th, 1902.	February 18th.

Name.	Proposed.	Elected.
Leigh, Arthur Graham	January 21st, 1903	February 18th.
Levy, Henry Wolff	April 2nd, 1903	June 17th.
Lewis, Harry Percy	November 19th, 1902	February 18th.
Linday, John Howard	May 20th, 1903	June 17th.
Livesey, Charles Edwin Leonard	May 7th, 1903	,, ,,
Lock, John George Collcutt	March 18th, 1903	April 22nd.
Macdonald, David Baird	November 5th, 1903	December 3rd.
Mander, Percy George	January 21st, 1903	February 18th.
Mann, Ernest William	November 5th, 1903	December 3rd.
Mann, John Christopher	April 22nd, 1903	June 17th.
McMahon, Frederick William	November 5th, 1903	December 3rd.
Monier-Williams, Gordon Wickham	,, ,,	,, ,,
Moore, Alfred Ernest	April 2nd, 1903	June 17th.
Moore, Arthur	May 20th, 1903	,, ,,
Nairne, Urban Orlando Scotchburn	November 5th, 1903	December 3rd.
Nevin, James Victor	,, ,,	,, ,,
Norman, George Marshall	April 2nd, 1903	June 17th.
O'Brien, Frederick	January 21st, 1903	February 18th.
Parry, George Harry	April 2nd, 1903	June 17th.
Parry, William	June 4th, 1903	December 3rd.
Pike, Henry George	November 5th, 1903	,, ,,
Pitt, Arthur Ernest	March 5th, 1903	April 22nd.
Pitt, Harold Russell	,, ,,	,, ,,
Plymen, George Horace Gladstone	November 5th, 1903	December 3rd.
Pollard, William Branch	,, ,,	,, ,,
Pond, George Gilbert	March 18th, 1903	April 22nd.
Porter, Robert James	,, ,,	,, ,,
Prasad, Mata	November 5th, 1903	December 3rd.
Prichard, George Montague	December 17th, 1902	February 18th.
Purcell, Charles Stanley	May 7th, 1903	June 17th.
Redfern, Herbert Stanley	June 17th, 1903	December 3rd.
Rhind, Thomas	May 20th, 1903	June 17th.
Rich, Stiles William George	November 5th, 1903	December 3rd.
Richardson, Harold Ernest	,, ,,	,, ,,
Robinson, Archibald Louis	February 18th, 1903	April 22nd.
Robertson, Frederick	March 5th, 1903	,, ,,
Robertson, Philip Wilfred	November 5th, 1903	December 3rd.
Rogers, William David	,, ,,	,, ,,
Roose, Fitzroy Owen Jonathan	March 5th, 1903	April 22nd.
Samuel, Thomas	November 19th, 1902	February 18th.
Sawdon, Ernest William	March 18th, 1903	April 22nd.
Scholefield, Albert Henry	December 17th, 1902	February 18th.
Senter, George	November 5th, 1903	December 3rd.
Sibley, Samuel Edward	December 4th, 1902	February 18th.
Siddle, George	February 5th, 1903	April 22nd
Slator, Arthur	November 5th, 1903	December 3rd.
Smith, Charles Joseph	May 20th, 1903	June 17th.
Smith, Frank Gurney	June 17th, 1903	December 3rd.
Smith, James Cruickshank	April 2nd, 1903	June 17th.
Smith, William Veysey	November 5th, 1903	December 3rd.
Steven, Alec Bowring	January 21st, 1903	February 18th.

Name.	Proposed.	Elected.
Stevens, Montague White	February 18th, 1903..	April 22nd.
Stevenson, Henry Edward	March 5th, 1903	,, ,,
Stewart, Alfred Walter	November 5th, 1903..	December 3rd.
Thomson, George Malcolm	January 21st, 1903 ...	February 18th.
Tighe, Arthur	November 5th, 1903. .	December 3rd.
Tilburn, Charles	December 17th, 1902.	February 18th.
Tolson, Stanley......................	January 21st, 1903 ...	,, ,,
Toyne, Francis Digby	,, ,,	,, ,,
Turner, Arnold	November 5th, 1903. .	December 3rd.
Turner, Duncan	December 4th, 1902..	February 18th.
Turner, William Ernest Stephen	November 5th, 1903. .	December 3rd.
Tyrrell, Dennis	May 7th, 1903...	June 17th.
Van Laer, Norbert	April 2nd, 1903	June 17th.
Wadmore, John Mello	November 19th, 1902.	February 18th.
Walker-Pole, Miles	November 5th, 1903..	December 3rd.
Walsh, Thomas Crosbie	January 21st, 1903 . .	February 18th.
Weiss, Carl Friederich Richard	November 5th, 1903..	December 3rd.
Welsford, Giles Hadden	March 18th, 1903 ...	April 22nd.
Wilkinson, James Bates	March 5th, 1903	,, ,,
Williams, David John	January 21st, 1903 ...	February 18th.
Wilmore, Albert	November 19th, 1902	,, ,,
Wood, William Francis John..	February 5th, 1903 ..	April 22nd.
Woolhouse, Sidney Herbert	May 20th, 1903	June 17th.
Worden, Edward Chancey	February 5th, 1903...	April 22nd.
Wright, Fred....................................	November 5th, 1903 .	December 3rd.
Yeomans, William Wade.....................	November 19th, 1902	February 18th.
Young, Andrew......................	December 17th, 1902.	,, ,,

FELLOWS DECEASED DURING 1903.

Name.	Elected.	Died.
*Adshead, Henry Guest	April 22nd	July 2nd.
Alexander, J. Owen	March 4th, 1897	September.
Barrows, Arthur Edward	June 16th, 1892	April 27th.
Bush, Baron William de	February 16th, 1882	July 24th.
Clift, Samuel	May 19th, 1856	May 5th.
Corfield, William Henry	March 1st, 1866	August 27th.
Demarçay, Eugene Anatole	December 15th, 1881	March 5th.
Fletcher, Thomas William	April 18th, 1872	September 20th.
Fulton, H. B.	March 1st, 1883	
Hendry, A. G.	December 1st, 1898	
James, Christopher	February 18th, 1888	May 11th.
Lawson, Thomas Atkinson	February 2nd, 1888	June 2nd.
Mactear, James	April 21st, 1864	June 3rd.
Reddrop, Joseph	January 15th, 1874	
Robertson, George Henry	December 4th, 1890	July 5th.
Schunck, Edward	March 15th, 1842	January 13th.

* Did not pay Admission Fee.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1903.

January 21*st*.

	Page in Proceedings.	Page in Transactions.
1. Researches on silicon compounds. Part VIII. Interactions of silicophenylamide with thiocarbimides. By J. Emerson Reynolds	6	252
2. On the relation between the absorption spectra and the chemical structure of corydaline, berberine, and other alkaloids. By J. J. Dobbie and A. Lauder ...	7	605
3. The absorption spectra of laudanine and laudanosine in relation to their chemical constitution. By J. J. Dobbie and A. Lauder	9	626
4. Pheno*cyclo*heptene. By F. S. Kipping and A. E. Hunter	11	246
5. The influence of molybdenum and tungsten trioxides on the specific rotations of *l*-lactic acid and potassium *l*-lactate. By G. G. Henderson and J. Prentice	12	259
6. Estimation of ethyl alcohol in essences and medicinal preparations. By T. E. Thorpe and John Holmes ...	13	314
7. Carbon monoxide as a product of combustion of the Bunsen burner. By T. E. Thorpe	14	318
8. Derivatives of β-resorcylic acid and of protocatechuic acid. By W. H. Perkin, jun., and E. Schiess	14	159*
9. Synthesis of imino-ethers. *N*-Ethyl-, *N*-methyl-, and *N*-benzyl-benziminoethers. By G. D. Lander	15	320
10. The condensation of phenyl ethyl ketone (propiophenone) with benzalacetophenone and of acetophenone with benzalpropiophenone. By R. D. Abell	17	360
11. A synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane. By R. D. Abell	18	367
12. Formation of carbazoles by the interaction of phenols, in the orthoketonic form, with arylhydrazines. By F. R. Japp and W. Maitland	19	267
13. Dimorphism of α-methylanhydracetonebenzil. By F. R. Japp and A. C. Michie	20	276
14. The oxidation products of the methyl homologues of anhydracetonebenzil. By F. R. Japp and A. C. Michie	21	279
15. Action of hypobromites on amides. By A. Lapworth and W. W. S. Nicholls	22	—
16. Derivatives of menthyl cyanoacetate. By D. A. Bowack and A. Lapworth	22	42*

	Page in Proceedings.	Page in Transactions.
17. The influence of nitro-groups on the reactivity of halogen derivatives of benzene. By A. Lapworth ...	23	—

February 5*th.*

	Page in Proceedings.	Page in Transactions.
18. The solubilities and transition points of lithium nitrate and its hydrates. By F. G. Donnan and B. C. Burt	37	335
19. The synthesis of αα-diglutaric acid By O. Silberrad and T. H. Easterfield	38	—
20. Distillation of chlorine water. By A. Richardson	39	380
21. A new vapour density apparatus. By John S. Lumsden	40	342
22. A new form of pyrometer. By John S. Lumsden	41	349
23. Tertiary butylphenol. By E. W. Lewis	41	329

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	Page in Proceedings.	Page in Transactions.
24. The molecular rearrangement of *N*-substituted iminoethers. By G. D. Lander	45	406
25. The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds. By G. D. Lander	47	414
26. The chlorine derivatives of pyridine. Part VIII. The interaction of 2 : 3 : 4 : 5-tetrachloropyridine with ethyl sodiomalonate. By W. J. Sell and F. W. Dootson	48	396
27. The biological method for resolving inactive acids into their optically active components. By A. McKenzie and A. Harden	48	424
28. Colour changes observed in solutions of cobalt chloride. By W. N. Hartley	49	401
29. The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. By S. Ruhemann	50	374
30. Derivatives of *p*-aminoacetophenone. By F. D. Chattaway	50	—

March 5*th.*

	Page in Proceedings.	Page in Transactions.
31. The mechanism of the reduction of potassium bichromate by sulphurous acid. By H. Bassett, jun.	54	692
32. The constitution of pilocarpine. Part IV. By H. A. D. Jowett	54	438
33. Preparation and properties of 1 : 4(or 1 : 5)-dimethylglyoxaline and 1 : 3-dimethylpyrazole. By H. A. D. Jowett and C. E. Potter	56	464
34. Camphor-β-thiol. By T. M. Lowry and G. C. Donington.....	57	479
35. Isomeric change of dibenzanilide into benzoyl-*o*-amino- and benzoyl-*p*-amino-benzophenones. By F. D. Chattaway	57	—

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36. Formation of purpurogallin by the electrolytic oxidation of pyrogallol. By A. G. Perkin and F. M. Perkin...	58	—
37. The analysis of *Reh*, the alkaline salts in Indian *usar* land. By E. G. Hill	58	—
38. Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid. By W. H. Perkin, jun., and J. F. Thorpe	61	—
39. The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient. By J. C. Cain and F. Nicoll	63	470
40. An analysis of the natural gas at Heathfield, Sussex. By H. B. Dixon and W. A. Bone	63	—
41. Chemical composition of cooked vegetable foods. By Miss K. I. Williams	66	—
42. The density of nitric oxide. Preliminary notice. By R. W. Gray	66	—
43. Hydrolysis of urea hydrochloride. By J. Walker and J. K. Wood...	67	484
44. The affinities of some feebly basic substances. By J. K. Wood	67	568

March 18*th*.

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45. Essential oil of hops. By A. C. Chapman	72	505
46. A compound of dextrose with aluminium hydroxide. By A. C. Chapman	74	—
47. Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin. By A. W. Crossley and P. Haas	75	494
48. The constitution of cotarnine. By J. J. Dobbie, A. Lauder, and C. K. Tinkler...	75	598
49. Decomposition of mercurous nitrite by heat. By P. C. Rây and J. N. Sen	78	491
50. The action of nitrogen tetroxide on pyridine. By J. F. Spencer	79	—

April 2*nd*.

	Page in Proceedings.	Page in Transactions.
51. The dioximes of camphorquinone, and other derivatives of *iso*nitrosocamphor. By M. O. Forster	97	514
52. Reversibility of enzyme or ferment action. By A. C. Hill	99	578
53. Discoloured rain. By E. G. Clayton	101	—
54. The absorption spectra of nitric acid in various states of concentration. By W. N. Hartley	103	658
55. Salts of an isomeric mercaptoid form of thioallophanic acid, and a new synthesis of alkyl iminothiocarbamates. By A. E. Dixon	104	550
56. Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone. By F. D. Chattaway	106	—

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57. Action of caustic alkalis on cinnamic acid dibromide and its esters. By J. J. Sudborough and K. J. Thompson	106	666
58. The composition of Caro's acid. By T. S. Price	107	543
April 22nd.		
59. The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution. By F. G. Donnan and R. Le Rossignol	120	703
60. A microscopic method of determining molecular weights. A preliminary note. By G. Barger	121	—
61. Note on the spectrum of pilocarpine nitrate. By W. N. Hartley	122	—
62. Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone. By F. D. Chattaway............	124	—
63. Note on the formation of di- and hexa-methylammonio-cadmium chlorides. By W. R. Lang............	125	724
May 7th.		
64. The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. Part II. By S. Ruhemann	128	717
65. Spontaneous decomposition of nitrocamphor. By T. M. Lowry	129	953
66. β-Bromo-α′-nitrocamphor and β-and π-bromocamphoryloximes. The influence of impurities in conditioning isomeric change. By T. M. Lowry	129	953
67. The electrolytic reduction of pheno- and naphthomorpholones. By F. H. Lees and F. Shedden	132	750
68. The coloured constituents of *Butea frondosa*. By E. G. Hill	133	—
69. Butein. A preliminary notice. By (the late) J. J. Hummel and A. G. Perkin	134	—
70. The relative affinities of polybasic acids. By H. M. Dawson	135	725
71. The chemical dynamics of the reactions between chlorine and benzene under the influence of different catalytic agents and of light. By A. Slator.	135	729
72. The diazo-reaction in the diphenyl series. Part I. On dianisidine and 3 : 3′-dichlorobenzidine. By J. C. Cain	136	688
May 20th.		
73. The conditions of decomposition of ammonium nitrite. By V. H. Veley............	142	736
74. Freezing point curves for some binary mixtures of organic substances, chiefly phenols and amines. By J. C. Philip............	143	814

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75. Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl-neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_3$. By G. Tattersall and F. S. Kipping	145	918
76. The action of liquefied ammonia on chromic chloride. By W. R. Lang and C. M. Carson	147	—
77. Note on the action of methylamine on chromic chloride. By W. R. Lang and E. H. Jolliffe	147	—
78. Cholesterol. Preliminary note. By R. H. Pickard and J. Yates	147	—
79. Hydrogen cyanide in fodder plants. By J. C. Brünnich	148	788
80. Sulphocampholenecarboxylic acid. By A. W. Harvey and A. Lapworth	148	1102
81. Optically active esters of β-ketoic and β-aldehydic acids. Part III. Azo-derivatives of menthyl acetoacetate. By A. Lapworth	149	1114
82. The chemical reactions involved in the rusting of iron. By W. R. Dunstan	150	—

June 4th.

83. Formation of an anhydride of camphoryloxime. By T. M. Lowry	156	953
84. Mutarotation of glucose as influenced by acids, bases, and salts. By T. M. Lowry	156	1314
85. The solubility of dynamic isomerides. By T. M. Lowry	156	—
86. The rusting of iron. By G. T. Moody	157	—
87. Imino-ethers corresponding with ortho-substituted benzenoid amides. By G. D. Lander and F. T. Jewson	160	766
88. The hydrolysis of ethyl mandelate by lipase. By H. D. Dakin	161	—
89. Isomeric change in benzene derivatives. The conditions influencing the interchange of halogen and hydroxyl in benzenediazonium hydroxides. By K. J. P. Orton	161	796
90. The synthesis of ααγ-trimethylglutaric acid, of the *cis*- and *trans*-modifications of β-hydroxy-ααγ-trimethylglutaric acid, and of ααγ-trimethylglutaconic acid. By W. H. Perkin, jun., and Alice E. Smith	163	771
91. Hexamethyleneoctocarboxylic acid and the *cis*- and *trans*-modification of hexamethylenetetracarboxylic acid (hexahydropyromellitic acid). By T. W. D. Gregory and W. H. Perkin, jun.	163	780
92. The bases contained in Scottish shale oil. Part II. By F. C. Garrett and J. A. Smythe	164	763
93. A direct method for determining the latent heat of evaporation. By J. Campbell Brown	164	937
94. Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_3$. By F. S. Kipping	164	902

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95. Isomeric compounds of the type $NR_1R_2H_3$. By F. S. Kipping	166	937

June 17th.

	Page in Proceedings.	Page in Transactions.
96. The estimation of arsenic in fuel. By T. E. Thorpe.	182	969
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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 259.

Wednesday, January 21st, 1903. Professor J. **Emerson Reynolds**, Sc.D., F.R.S., President, in the Chair.

Mr. W. H. Edwards was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

George Henry Appleyard, 151, Cleveland Street, Hull.
Samuel Bradbury, Thornham New Road, Castleton.
George Thomas Branch, Claremont, Cape Town, S. Africa.
Hubert William Bywaters, 11, King Street, Regent Street, W.
William Henry Cadman, Lord Williams's Grammar School, Thame.
John Castell-Evans, 141, Ferme Park Road, Crouch End, N.
Arthur John Codling, 5, Tavistock Square, W.C.
Benjamin Claxton Coyle, 65, Lansdowne Road, Dublin.
Cecil Henry Desch, Instow, Mount Pleasant Road, Tottenham, N.

Leonard King Hindmarsh, 354, Lordship Lane, S.E.
Franklin Wise Howorth, Rose Bank, Elmdale Road, Palmers Green, N.
Arthur Graham Leigh, Chorcliff House, Chorley.
Percy George Mander, Spon House, Spon End, Coventry.
Frederick O'Brien, 15, Lilymead Avenue, Knowle, Bristol.
Alec Bowring Steven, Ness House, Surbiton.
George Malcolm Thomson, Newington, Dunedin, N.Z.
Stanley Tolson, 14, Furnivall Road, Balby, Doncaster.
Francis Digby Toyne, Santubong, Sarawak.
Thomas Crosbie Walsh, "Sunnyside," Muswell Avenue, Muswell Hill, N.
David John Williams, 1, St. Agnes Place, Kennington Park, S.E.

The Secretary announced that a communication had been received from Profs. Börnstein and Meyerhoffer stating that they were engaged in revising the *Physikalisch-chemische Tabellen* of Landolt and Börnstein, and would welcome from English chemists any suggestions of alterations or corrections for the new edition, addressed to them, "care of Verlag von Julius Springer, Berlin, N."

The Council has ordered the following report to be printed in the Journal and in the Proceedings of the Society:

Report of the International Committee on Atomic Weights.

In the year 1900, an International Committee on atomic weights was organised, composed of more than fifty representatives from chemical and other societies. Its conferences were necessarily conducted by correspondence, and the delays and difficulties of the work proved to be both serious and annoying. Accordingly, the Committee, by vote, designated a smaller body of three representatives, and the latter now has the honour to report its recommendations.

On the fundamental question of standards, definite and formal action seems to be impracticable. By the original committee of the German Chemical Society, the oxygen standard was adopted, but that proposal, whilst receiving strong support, also met with serious opposition. In fact, opinion as expressed by individual voices seems to be somewhat evenly divided upon this question, and around it there has already grown up a controversial literature of formidable proportions. To force the adoption of either standard, oxygen, or hydrogen, appears therefore to be impossible, and for some time to come both are likely to be employed. Between them, experience must be the final arbiter. That standard which best serves to co-ordinate chemical and physical knowledge will ultimately be chosen, and the other will gradually fall into disuse. Meanwhile, it is important that the most probable values for the several atomic weights should be indicated, and that every table of them should be consistent within itself. Such a table has been prepared by our distinguished predecessors and its revision, as knowledge advances, seems to be our proper function.

In order that our work may be of the most general service, we have prepared a table in which both standards of atomic weight are represented. In most of its details it is identical with the table which was reported by the previous committee at the beginning of the year 1902.* Some changes, however, have, in our judgment, become necessary, and these may be briefly indicated as follows:

Antimony.—In the former reports of the committee, the value derived by Cooke from analyses of the bromide, Sb = 120, was adopted. This, however, ignores the work of Cooke and of Schneider upon antimony trisulphide, and the still more recent determinations made by Friend and Smith. The true number being therefore in doubt, we recommend the use of an average value, and put Sb = 120·2.†

Germanium.—The number 72·5 is more nearly in accord with Winkler's determinations than the former number 72.

Hydrogen.—In the column which represents the oxygen standard, hydrogen has heretofore been assigned the value 1·01. The number 1·008 is, however, much more exact, and the error in 1·01 is too large to be perpetuated. Each figure should be given to the nearest *significant* decimal.

Lanthanum.—During 1902, two new determinations of the atomic weight of lanthanum were published. According to Jones, La = 138·77. Brauner and Pavlíček found La = 139·04. Both investigations were conducted with great skill and care, and each one seems to have some points of advantage over the other. The average, La = 138·9, appears to be the safest value to adopt. These data naturally influence our judgment in the case of cerium, and we retain Brauner's number, Ce = 140, rather than adopt the lower estimates made by other observers.

Mercury.—Taking into account all the determinations which have appeared, and giving great weight to the most recent measurements by Hardin, we regard the value Hg = 200 as best warranted by the existing evidence.

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* In No. 1 of the *Berichte* for 1902.

† O = 16.

Palladium.—The atomic weight of this metal is in doubt. The best determinations give values ranging from 106 to 107. The mean between them, Pd = 106·5, has been provisionally adopted.

Radium.—This element appears in the table for the first time. Madame Curie's determination of the atomic weight, Ra = 225, is probably not far from the truth.

Selenium.—Judging from the work of Lenher, and the very recent determinations by Jul. Meyer, the former value, Se = 79·1, is probably too low. In order to give due weight to the newer measurements, we write Se = 79·2.

Tin.—The determinations by Bongartz and Classen, which seem to be the best, make Sn = 119. The former value, 118·5, is almost certainly too low.

Uranium.—According to the very recent investigation by Richards and Merigold, the atomic weight of uranium is 238·5.

Zirconium.—The figure Zr = 90·6 is apparently the most probable.

In thus assuming the duties assigned to us by the larger International Committee, we act upon the conviction that the purpose of our appointment is to secure the promptness and efficiency which is only possible with a comparatively small working body. In order to carry out this purpose, we must depend upon the co-operation and assistance of our colleagues. We therefore beg that they, and also all other chemists who are interested in researches upon atomic weights, will aid us with their criticisms and advice. We especially ask that publications upon the subject shall be sent to us, in triplicate if possible, so that no matter of importance may be overlooked. Without support of this kind our work cannot be made fully effective.

The complete table of atomic weights, with foregoing changes incorporated, follows.

F. W. Clarke
T. E. Thorpe } *Committee.*
Karl Seubert

1903.

International Atomic Weights.

		O=16.	H=1.
Aluminium	Al	27·1	26·9
Antimony	Sb	120·2	119·3
Argon	A	39·9	39·6
Arsenic	As	75·0	74·4
Barium	Ba	137·4	136·4
Bismuth	Bi	208·5	206·9
Boron	B	11	10·9
Bromine	Br	79·96	79·36
Cadmium	Cd	112·4	111·6
Cæsium	Cs	133	132
Calcium	Ca	40·1	39·8
Carbon	C	12·00	11·91
Cerium	Ce	140	139
Chlorine	Cl	35·45	35·18
Chromium	Cr	52·1	51·7
Cobalt	Co	59·0	58·56
Columbium (Niobium)	Cb	94	93·3
Copper	Cu	63·6	63·1
Erbium	E	166	164·8
Fluorine	F	19	18·9
Gadolinium	Gd	156	155
Gallium	Ga	70	69·5
Germanium	Ge	72·5	71·9
Glucinum (Beryllium)	Gl	9·1	9·03
Gold	Au	197·2	195·7
Helium	He	4	4
Hydrogen	H	1·008	1·000
Indium	In	114	113·1
Iodine	I	126·85	125·90
Iridium	Ir	193·0	191·5
Iron	Fe	55·9	55·5
Krypton	Kr	81·8	81·2
Lanthanum	La	138·9	137·9
Lead	Pb	206·9	205·35
Lithium	Li	7·03	6·98
Magnesium	Mg	24·36	24·18
Manganese	Mn	55·0	54·6
Mercury	Hg	200·0	198·5
Molybdenum	Mo	96·0	95·3
Neodymium	Nd	143·6	142·5
Neon	Ne	20	19·9
Nickel	Ni	58·7	58·3
Nitrogen	N	14·04	13·93
Osmium	Os	191	189·6
Oxygen	O	16·00	15·88
Palladium	Pd	106·5	105·7
Phosphorus	P	31·0	30·77
Platinum	Pt	194·8	193·3
Potassium	K	39·15	38·86
Praseodymium	Pr	140·5	139·4
Radium	Ra	225	223·3
Rhodium	Rh	103·0	102·2
Rubidium	Rb	85·4	84·8
Ruthenium	Ru	101·7	100·9
Samarium	Sm	150	148·9
Scandium	Sc	44·1	43·8
Selenium	Se	79·2	78·6
Silicon	Si	28·4	28·2
Silver	Ag	107·93	107·12
Sodium	Na	23·05	22·88
Strontium	Sr	87·6	86·94
Sulphur	S	32·06	31·83
Tantalum	Ta	183	181·6
Tellurium	Te	127·6	126·6
Terbium	Tb	160	158·8
Thallium	Tl	204·1	202·6
Thorium	Th	232·5	230·8
Thulium	Tm	171	169·7
Tin	Sn	119·0	118·1
Titanium	Ti	48·1	47·7
Tungsten	W	184·0	182·6
Uranium	U	238·5	236·7
Vanadium	V	51·2	50·8
Xenon	X	128	127
Ytterbium	Yb	173·0	171·7
Yttrium	Yt	89·0	88·3
Zinc	Zn	65·4	64·9
Zirconium	Zr	90·6	89·9

Of the following papers, those marked * were read :

*1. " Researches on silicon compounds. Part VIII. Interactions of silicophenylamide with thiocarbimides." By J. Emerson Reynolds.

The author has shown that the fine, crystalline silicophenylamide, $Si(NHC_6H_5)_4$, described in part V of this series of papers, loses aniline on careful heating and affords, first, silicotriphenylguanidine and, subsequently, silicodiphenylimide (*Trans.*, 1900, 77, 836).

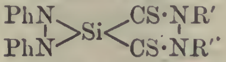
The comparative ease and completeness with which the change $Si(NHPh)_4 = Si(NPh)_2 + 2NH_2Ph$ can be realised suggested another mode of producing the di-imide, involving the action of thiocarbimides. It was anticipated that silicophenylamide would react in the following manner : $Si(NHPh)_4 + 2R'N{:}CS = Si(NPh)_2 + 2CSN_2H_2PhR'$.

Whilst the above change can be realised, the author showed that the marked tendency of silicon to form complex molecules lead to other and unexpected interactions with thiocarbimides, and found that :

1. Silicophenylamide in benzene solution is not decomposed by a thiocarbimide, even at the boiling point of the solvent, but addition compounds are formed. For example, ethyl thiocarbimide in excess gives fine, needle-like crystals consisting of $Si(NHPh)_4,2EtNCS$, and, when not in excess, rhombic plates of $Si(NHPh)_4,EtNCS$. Both compounds lose the whole of the thiocarbimide at 100° and leave silicophenylamide unchanged.

2. A very different result is obtained when one molecule of silicophenylamide and two molecules of a thiocarbimide, without a solvent, are heated in sealed tubes at 160°. At first, the two compounds unite directly as before, but when the temperature rises to 140° a thick, slightly brown liquid begins to form, the production of which is complete on heating to 160° for half an hour. At the ordinary temperature, this substance is a very viscid liquid, and a specimen of the ethyl compound has been kept for several months without separation of any crystals. Methyl, ethyl and phenyl thiocarbimides afford similar products, which have no odour of thiocarbimide, even when strongly heated ; they are easily miscible with benzene, from which they are precipitated on addition of ligroin, and may thus be purified by a repetition of this treatment. Prolonged digestion of the benzene solution of each substance leads to a slow separation of silicodiphenylimide, whilst the liquid affords crystals of a disubstituted thiocarbamide. Therefore the interaction anticipated actually does take place

at a sufficiently high temperature, but the resulting silicon di-imide and thiocarbamide unite to form a homogeneous liquid consisting of $Si(NPh)_2,2CSN_2H_2PhR'$, which is slowly dissociated in boiling benzene.

3. Silicophenylamide also interacts with 4 molecules of thiocarbimides at 160°, but not with more than 4 molecules. The products are also viscid liquids at first, but they are not homogeneous, as crystals form to a relatively small extent in the mass on standing for some time, and are those of a substituted thiocarbamide. The liquid portion consists, in each case, of a new substance resulting from the action of the two additional molecules of thiocarbimide on the silicon di-imide produced in the first interaction. These liquids are miscible wlth benzene, but do not dissociate in it; they are decomposed by alcohol and afford ethyl orthosilicate, alkyl dithiocarbamate, and a guanidine derivative, hence their constitution is probably  $\begin{array}{l}\mathrm{PhN}\\ \;\;|\\ \mathrm{PhN}\end{array}\!>\mathrm{Si}<\!\begin{array}{l}\mathrm{CS{\cdot}NR'}\\ \quad\;\;|\\ \mathrm{CS{\cdot}NR''}\end{array}$.

Silicodiphenylimide, produced by heat from silicophenylamide, combines directly with thiocarbimides to form compounds of this type.

*2. "On the relation between the absorption spectra and the chemical structure of corydaline, berberine, and other alkaloids." By J. J. Dobbie and A. Lauder.

It has been proved by purely chemical investigations that corydaline and berberine are closely related to one another and that both alkaloids are constructed on the same general plan as papaverine, narcotine, hydrastine, and narceine.

An examination of the absorption spectra of the members of this group of alkaloids shows that those which are most closely related structurally give similar spectra, the differences in the spectra becoming more pronounced as the structural differences increase in importance. Thus corydaline and tetrahydroberberine closely resemble each other in structure, and the spectra of the latter only differ from those of the former in the somewhat greater general absorption which they exhibit. Narcotine only differs from hydrastine in containing an additional methoxyl group, and their spectra are almost identical, but quite distinct from those of corydaline, from which both differ considerably in structure. Papaverine and narceine are constitutionally still further removed from corydaline, and their spectra show a correspondingly increased difference as compared with those of the other members of the group. When papaverine, however, is reduced to tetrahydropapaverine, its constitution then corresponds much more closely with that of corydaline, and the spectra of the reduced compound are similar to those of corydaline.

When the corresponding derivatives of corydaline and tetrahydroberberine are compared, it is seen that the latter only differ from the former in possessing a slightly greater absorptive power. Since the only structural difference between the two series of derivatives consists in the replacement of two of the methoxyl radicles of corydaline by the dioxymethylene group in berberine, it was inferred that the difference in the amount of general absorption must be due to this difference of structure and that the dioxymethylene complex must consequently exert a more powerful absorption than two methoxyl groups. The correctness of this inference received support from the direct comparison of the spectra of piperonylic acid, $C_6H_3(O_2CH_2)CO_2H$, with those of veratric acid, $C_6H_3(OMe)_2{\cdot}CO_2H$.

Whilst the spectra of ω-aminoethylpiperonylcarboxylic anhydride, $C_9H_7NO(O_2CH_2)$, from berberine, and of corydaldine, $C_9H_7NO(OMe)_2$, from corydaline are very similar, they differ widely from those of cotarnine and hydrastinine, the corresponding oxidation products of narcotine and hydrastine respectively. This difference finds a sufficient explanation in the fact that the pyridine ring, which is closed in corydaldine and ω-aminoethylpiperonylcarboxylic anhydride, is open in cotarnine and hydrastinine. The action of potassium hydroxide converts hydrastinine into oxyhydrastinine, in which the pyridine ring is closed. The spectra of oxyhydrastinine, and corydaldine are almost identical.

Hartley (*Phil. Trans.*, 1885, Pt. II., 471) has already shown that many of the alkaloids give highly characteristic spectra and has pointed out the applicability of the method to the study of their constitution. The authors draw certain general conclusions as to the relation between the structure and the absorption spectra of the alkaloids. These conclusions are based chiefly on the results of the examination of the alkaloids of the corydaline group, but are supported by the results of the examination of other alkaloids.

Alkaloids which differ essentially in structure, even when their molecular formulæ are the same, give dissimilar spectra, whilst alkaloids which are closely related structurally give similar spectra, and sometimes, when the structural resemblance is very close, spectra which are indistinguishable from one another.

Stereoisomeric alkaloids give identical spectra. In the examination of stereoisomeric phenomena, the spectroscope affords a means of determining whether two substances of the same formula, the one active and the other inactive, are related to one another as stereoisomerides. If they give different spectra, it can be inferred with great certainty that they differ structurally.

Homologous alkaloids give practically the same spectra. The formula of bulbocapnine differs from that of tetrahydroberberine and papaverine only by CH_2, but the wide difference between the spectra of all three substances precludes the possibility that bulbocapnine is homologously related to either. Whilst important differences of structure are always accompanied by marked differences in the spectra, many of the structural details of an alkaloid may be modified without any appreciable effect being produced in the spectra. An example of this is afforded by the replacement of two of the methoxyl groups of corydaline by the dioxymethylene group in berberine. When, therefore, two alkaloids give spectra which are nearly, but not quite, identical, it may be inferred with considerable probability that they differ only in minor details of structure. In such cases, a preliminary spectroscopic examination would sometimes give a clue to the constitution of an alkaloid which would greatly facilitate the chemical investigation.

*3. "The absorption spectra of laudanine and laudanosine in relation to their chemical constitution." By J. J. Dobbie and A. Lauder.

In this paper, the absorption spectra of laudanine, $C_{20}H_{25}O_4N$, and laudanosine, $C_{21}H_{27}O_4N$, two rare opium alkaloids discovered by Hesse, are described. They are shown to be practically identical with one another and, further, to resemble very closely the spectra of corydaline and tetrahydropapaverine (see preceding abstract). The close resemblance between the spectra of laudanine and laudanosine confirms the view that they are homologous bodies, whilst the close agreement with the spectra of corydaline and tetrahydropapaverine points to the possession of a structure similar to that of these alkaloids.

For reasons given below, the relationship with corydaline is probably somewhat closer than with tetrahydropapaverine. Laudanosine has one atom of carbon less than corydaline, the number of hydrogen, oxygen, and nitrogen atoms being the same in both. Assuming the formulæ of the two alkaloids to have been correctly determined, the difference between them may conceivably consist in the absence from laudanosine of the methyl group which is present in corydaline and in the partial reduction of one of its rings,

$$\underset{\text{Corydaline.}}{C_{22}H_{27}O_4N} - CH_2 + H_2 = \underset{\text{Laudanosine.}}{C_{21}H_{27}O_4N}.$$

In this way, the close agreement of the spectra might be accounted for. The absence of the methyl group would produce no appreciable effect, and it is known from the examination of a number of cases that the introduction of two atoms of hydrogen into a molecule is not necessarily accompanied by any notable modification of its spectra. The spectroscopic evidence as to the close relationship subsisting between laudanosine and corydaline is substantiated by the little which is known concerning the chemistry of the former alkaloid. Like corydaline, it contains four methoxyl groups and yields metahemipinic acid as one of its oxidation products. It further resembles corydaline in the ease with which it is oxidised by nitric acid to a yellow base. This basic product has not been analysed, but it is not improbably identical with meconidine, an alkaloid associated with laudanosine in opium. The formula of meconidine is $C_{21}H_{23}O_4N$ and bears the same relationship to that of laudanosine that the formulæ of dehydrocorydaline and berberine respectively bear to those of corydaline and tetrahydroberberine.

Colourless :

Corydaline.	Tetrahydroberberine.	Laudanosine.
$C_{22}H_{27}O_4N$.	$C_{20}H_{21}O_4N$.	$C_{21}H_{27}O_4N$.
M. p. 135·5°.	M. p. 167°.	M. p. 89°.

Yellow :

Dehydrocorydaline.	Berberine.	Meconidine.
$C_{22}H_{23}O_4N$.	$C_{20}H_{17}O_4N$.	$C_{21}H_{23}O_4N$.
M. p. 118—120°.	M. p. 145°.	M. p. 58°.

Whether the yellow substance produced by the oxidation of laudanosine is identical with meconidine or not, the mere fact of the existence in opium of the coloured base having a formula differing from that of laudanosine by four atoms of hydrogen affords support to this view of the relationship of these substances, and this hypothesis receives additional confirmation from a comparison of the melting points of the substances.

Discussion.

Dr. Jowett asked if the authors had tried the method with stereoisomeric alkaloids like atropine and hyoscyamine or the scopolamines, or whether the method had been confined to those alkaloids with a quinoline or *iso*quinoline nucleus. If the method was of general application, it would prove of great service in distinguishing between stereoisomerides and isomeric alkaloids differing structurally.

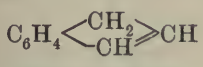
Professor Dunstan remarked that Dr. Dobbie had made a distinct step in advance in the direction of showing how these absorption spectra, for a knowledge of which chemists owe so much to Professor

Hartley, may be definitely utilised as a criterion in determining the general molecular structure of alkaloids. Though possibly of limited application, the method promised to be of value in dealing with cases, such as those now brought forward by Professor Dobbie, where chemical methods were not yet available or applicable.

Professor Dobbie, in reply, said that although he and Mr. Lauder had incidentally examined some of the pyridine alkaloids, they had not made any systematic study of them, as they had of the alkaloids of high molecular weight.

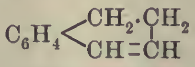
4. "Pheno*cyclo*heptene." By F. S. Kipping and A. E. Hunter.

The dry hydrochloride of pheno-*a*-amino*cyclo*heptane (Kipping and Hunter, *Trans.*, 1901, **79**, 602) undergoes decomposition at about 240°, giving ammonium chloride and pheno*cyclo*heptene, a homologue of indene and of dihydronaphthalene:



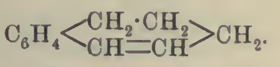
$C_6H_4<\begin{matrix}CH_2\\CH\end{matrix}>CH$

Pheno*cyclo*pentene.
(Indene.)



$C_6H_4<\begin{matrix}CH_2\cdot CH_2\\CH{=}CH\end{matrix}$

Pheno*cyclo*hexene.
(Dihydronaphthalene.)



$C_6H_4<\begin{matrix}CH_2\cdot CH_2\\CH{=}CH\end{matrix}>CH_2.$

Pheno*cyclo*heptene.

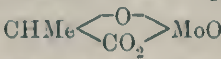
*Pheno*cyclo*heptene*, $C_{11}H_{12}$, a colourless liquid having an odour which recalls that of indene, boils at 233·5—234° (757 mm.) and has a sp. gr. 1·009 at 4°/4°. It differs from indene in chemical properties as it neither gives a picrate nor a condensation product with benzaldehyde in presence of sodium ethoxide.

On oxidation with potassium permanganate in alkaline solution at the ordinary temperature, pheno*cyclo*heptene is converted into an acid identical with the phenylbutyric-*o*-carboxylic acid, $CO_2H\cdot C_6H_4\cdot[CH_2]_3\cdot CO_2H$, prepared synthetically by Roser (*Ber.*, 1885, **18**, 3118); this acid seems to be dimorphous as, when first produced, it crystallises in needles melting at 122° and subsequently in plates melting at 138°, the latter being the form obtained by Roser, but the conditions which determine the formation of the one or other modification could not be ascertained. On oxidation with hot, very dilute nitric acid, the unsaturated hydrocarbon gives the form melting at 138°.

5. "The influence of molybdenum and tungsten trioxides on the specific rotations of *l*-lactic acid and potassium *l*-lactate." By G. G. Henderson and J. Prentice.

Both molybdenum trioxide and tungsten trioxide are dissolved by a hot aqueous solution of potassium *l*-lactate, the former readily, but the latter with greater difficulty. In each case, the specific rotation increases with the quantity of oxide in solution and reaches a maximum ($[\alpha]_D^{20^\circ} = +22{\cdot}69^\circ$ and $+10{\cdot}8^\circ$ respectively) when the substances are present in the proportion of 2 molecules of $C_3H_5O_3K$ to 1 molecule of RO_3. At this point, the solutions are practically saturated with the oxides, for, although a little more of each oxide can be dissolved in the heat, decomposition then ensues, and the solutions become coloured blue or brown according as molybdenum or tungsten trioxide is used. These results point to the formation of potassium molybdilactate and tungstilactate according to the equation: $2C_3H_5O_3K + RO_3 = RO_2(C_3H_4O_3K)_2 + H_2O$.

Sodium molybdate and tungstate are readily dissolved by an aqueous solution of *l*-lactic acid, the specific rotation increasing in each case as larger quantities of the salt are added. The highest readings ($[\alpha]_D^{20^\circ} = +21{\cdot}15^\circ$ and $+9{\cdot}9^\circ$) are obtained when the solutions contain 1 molecule of Na_2RO_4 for each 2 molecules of $C_3H_6O_3$, and if a larger quantity of either salt is added the rotation diminishes. It seems, therefore, that a reaction occurs in the sense of the equation $2C_3H_6O_3 + Na_2RO_4 = RO_2(C_3H_4O_3Na)_2 + 2H_2O$, sodium molybdilactate and tungstilactate being formed.

Molybdenum trioxide is also dissolved by an aqueous solution of *l*-lactic acid, but the compound formed in the solution is decomposed by exposure to heat or even to diffused daylight, and hence the process of dissolution must be carried on in the cold and in a dark place. The specific rotation increases as the oxide is added and reaches a maximum ($[\alpha]_D^{20^\circ} = +24{\cdot}78^\circ$) when 1 molecule of MoO_3 is present for each 1 molecule of $C_3H_6O_3$, diminishing again on the addition of more oxide. This result indicates the formation of a compound $CHMe(CO_2H)O{\cdot}MoO_2{\cdot}OH$, or more probably  $CHMe\left\langle\genfrac{}{}{0pt}{}{O}{CO_2}\right\rangle MoO_2$. The sensibility to light of the solution is so great that a good print from a negative can be taken on paper saturated with the solution and dried in the dark, but the blue colour of the print fades away in the absence of light.

Tungsten trioxide was found to be practically insoluble in an aqueous solution of *l*-lactic acid.

According to the views formerly expressed (*Trans.*, 1899, 75, 542) regarding the constitution of the "tartar emetic" class of compounds, molybdenum and tungsten trioxides should react with lactates, yielding derivatives of the type $RO_2(O{\cdot}CHMe{\cdot}CO_2M)_2$, and the results of this investigation point to the formation of compounds having this composition.

6. "Estimation of ethyl alcohol in essences and medicinal preparations." By T. E. Thorpe and John Holmes.

The authors described a method of estimating ordinary alcohol in essences and medicinal preparations containing essential oils and volatile substances, such as ether, chloroform, benzaldehyde, camphor, compound ethers, and which has been used for some time past in the Government Laboratory and which has been found to be both accurate and of very general applicability.

It is as follows: 25 c.c. of the sample, measured at 15·5°, are mixed with water in a separator to a bulk of from 100 to 150 c.c., and common salt is added in sufficient quantity to saturate the liquid. The mixture is now shaken vigorously for 5 minutes with from 50 to 80 c.c. of light petroleum boiling below 60°, and after standing for about half an hour the lower layer is drawn off into another separator, extracted, if necessary, a second time with petroleum, and then introduced into a distillation flask. Meanwhile, the petroleum layers are washed successively with 25 c.c. of saturated brine, the washings added to the main bulk, which is neutralised if necessary, and then distilled, and the distillate made up to 100 c.c. and its relative density determined at the standard temperature in the usual manner. The results thus obtained require a small correction from the circumstance that, as the alcohol present is distilled into four times its initial volume, the errors of the spirit tables are necessarily quadrupled. Details were given of the mode in which the magnitude of this error may be determined, and from these results the mean error of the tables at below 40 per cent. proof (for example, 0·972 sp. gr.), which is the particular section of tables mainly used, may be set down as $+0{\cdot}2$ per cent. of proof spirit, and hence the observed determinations, expressed as percentages of proof spirit, require a subtractive correction of 0·8 per cent.

Tables were given of results obtained on preparations actually made in the laboratory and containing known quantities of ethyl alcohol as evidence of the accuracy and general applicability of the method and of the degree of variation which may be expected to occur between the results of different operators.

7. "Carbon monoxide as a product of combustion of the Bunsen burner." By T. E. Thorpe.

The author, in the course of an inquiry into the nature of the combustion-products of certain of the gas- and oil-stoves in common use, has had occasion to make observations on the behaviour of the Bunsen burner as regards its liability to evolve carbon monoxide when burning under an ordinary laboratory sand-tray. He finds that a burner fed with coal-gas at the rate of 6 cubic feet per hour and under 0·95 inch pressure will evolve about 0·022 cubic foot of carbon monoxide when burnt under a sand-tray in such manner that the inner cone of the flame impinges, or apparently impinges, on the metal.

8. "Derivatives of β-resorcylic acid and of protocatechuic acid." By W. H. Perkin, junr., and E. Schiess.

The authors have been engaged for some time in the investigation of some derivatives of these acids, and the appearance of a paper by Bülow and Riess (*Ber.*, 1902, **35**, 3900), which deals with somewhat similar derivatives obtained from α-resorcylic acid, has necessitated the publication of the following short account of their results.

Methyl dimethyl-β-resorcylate, $(OMe)_2C_6H_3{\cdot}CO_2Me$, is readily obtained as a colourless oil boiling at 160—162° under 13 mm. pressure when β-resorcylic acid is treated with potassium hydroxide and methyl sulphate in aqueous solution. The corresponding ethyl dimethyl-β-resorcylate boils at 170° under 13 mm. pressure.

2 : 4-*Dimethoxybenzoylacetophenone*, $(OMe)_2C_6H_3{\cdot}CO{\cdot}CH_2{\cdot}COPh$, is produced when sodium acts on a mixture of ethyl dimethylresorcylate and acetophenone dissolved in dry ether; it crystallises in plates, melts at 55°, and develops a brownish-red coloration with alcoholic ferric chloride. The ethereal solution gives, with copper acetate, the copper compound $C_{34}H_{30}O_8Cu$, which crystallises from benzene in slender, green needles containing one molecule of benzene.

2 : 4-*Dimethoxycinnamic acid*, $(OMe)_2C_6H_3{\cdot}CH{:}CH{\cdot}CO_2H$, which has already been obtained from methylumbelliferone by Will and Tiemann (*Ber.*, 1882, **15**, 2080; 1883, **16**, 2116) in two modifications (α- and β-) melting respectively at 138° and 184°, may be easily prepared synthetically by digesting dimethylresorcylaldehyde (2 : 4-dimethoxybenzaldehyde), $(OMe)_2C_6H_3{\cdot}CHO$, with sodium acetate and acetic anhydride in the usual manner. The acid obtained in this way by the authors was the β modification melting at 184°.

The *ethyl* salt, $(OMe)_2C_6H_3\cdot CH\dot{:}CH\cdot CO_2Et$, is very conveniently prepared, in a yield of 80 per cent., by treating a mixture of dimethylresorcylaldehyde and ethyl acetate with sodium (compare Claisen, *Ber.*, 1890, **23**, 977); it is a colourless oil distilling at 208° under 13 mm. pressure.

3 : 4-*Dimethoxycinnamic acid* may be obtained by treating dimethylcatecholaldehyde (3 : 4-dimethoxybenzaldehyde) in a similar manner; it crystallises from acetic acid in needles, melts at 180°, and is identical with the acid which Tiemann and Will (*Ber.*, 1881, **14**, 960) first prepared from caffeic and ferulic acids by treatment with potassium hydroxide and methyl iodide. Its *ethyl* salt may be prepared from the acid by esterification in the usual manner, but much more conveniently by acting on a mixture of dimethylcatecholaldehyde and ethyl acetate with sodium. It crystallises from light petroleum in plates, melts at 59°, and distils at 196—197° under a pressure of 11 mm.

Ethyl 3 : 4-*dimethoxyphenyl*-α : β-*dibromopropionate*,

$$(OMe)_2C_6H_3\cdot CHBr\cdot CHBr\cdot CO_2Et,$$

which is formed when the last-mentioned ethyl salt is treated with bromine in chloroform solution, melts at 111°, and, when hydrolysed with excess of alcoholic potash, is converted into 3 : 4-*dimethoxyphenylpropiolic acid*, $(OMe)_2C_6H_3\cdot C\vdots C\cdot CO_2H$, a colourless, crystalline substance melting at 149°. A detailed investigation of the above substances and their derivatives is in progress.

9. "Synthesis of imino-ethers. *N*-Ethyl-, *N*-methyl-, and *N*-benzylbenziminoethers." By G. D. Lander.

Alkylation by means of silver oxide and alkyl iodides occurs to a very limited extent with the alkyl and benzyl benzamides, and the imino-ethers were therefore prepared from the imide chlorides by means of the sodium alkyloxides (*Trans.*, 1902, **81**, 591). The *N*-ethyl and *N*-methyl derivatives are contaminated with compounds of higher boiling points containing a smaller percentage of carbon, which may be ortho-compounds of the type $CPh(OR)_2NHR'$. The purification of the imino-ethers is effected by warming with 1/10 molecule of acetic anhydride.

The *imide chloride* of *benzethylamide*, $CPhCl\dot{:}NEt$, boils at 110—111° (15 mm.) and gives, on treatment with aniline, *ethylphenylbenzenylamidine*, $CPh(\dot{:}NEt)\cdot NHPh$; this base, which melts at 74—76°, is also obtained by condensing aniline with the imino-ether; its platinichloride crystallises with $2H_2O$ and melts at 204°.

N-*Ethylbenzimino-ethyl ether*, CPh(OEt):NEt, and N-*ethylbenzimino-methyl ether*, CPh(OMe):NEt, boil at 105° and 97—100° under 11 mm. pressure, and at 221—223° and 209—212° (uncorr.) under the ordinary pressure, respectively; they are colourless, limpid liquids of amine-like odour.

Benzoyldiethylbenzenylamidine, CPh(:NEt)·NEt·COPh, a basic bye-product of the imino-ether synthesis, crystallises in colourless prisms melting at 90—91·5° without decomposition; its *platinichloride* melts at 151—151·5°, and its solution, in dilute hydrochloric acid, gradually decomposes with the formation of benzoic acid, ethylamine, and a compound (m. p. 101—102°) not yet examined.

N-*Methylbenziminomethyl ether*, CPh(OMe):NMe, boils at 94—95° under 12 mm., and at 203—206° (uncorr.) under the ordinary pressure; the crude hydrochloride melts at 65—70°, regenerating benzmethylamide.

N-*Methylbenziminoethyl ether*, CPh(OEt):NMe, was not obtained pure; it boils at about 105° under 14 mm., and at about 215° under the ordinary pressure.

Benzoyldimethylbenzenylamidine, CPh(:NMe)·NMe·COPh, which resembles the diethyl compound in crystalline form and properties, melts at 116—117·5°, its *platinichloride* melts at 184—185°.

The *imide chloride of benzbenzylamide*, $CPhCl:NCH_2Ph$ (compare *Ber.*, 1897, 30, 1788), decomposes, almost completely, on distillation into benzonitrile and benzylchloride, but the undistilled imide chloride condenses with aniline yielding *phenylbenzylbenzenylamidine*, $CPh(:NCH_2Ph)·NHPh$, which melts at 99—100°, and is identical with Beckmann and Fellrath's base obtained from benzphenylamide imide chloride and benzylamine, and also with the amidine formed by condensation of *N*-benzylbenzimino-ethyl ether with aniline. *Phenylmethylbenzylbenzenylamidine*, $CPh(:NCH_2Ph)·NMePh$, which is produced either from methylaniline and the imide chloride of benzbenzylamide, or by alkylating the above described amidine with methyl iodide, melts at 89—90°.

N-*Benzylbenzimino-ethyl ether*, $CPh(OEt):NCH_2Ph$, is a viscid, colourless, odourless oil, boiling at 186—188° under 12 mm. pressure; the corresponding *methyl ether*, $CPh(OMe):NCH_2Ph$, boils at 178—180° under 11 mm pressure. These *N*-benzylbenzimino-ethers, when left in contact with air, undergo oxidation to dibenzamide.

10. “The condensation of phenyl ethyl ketone (propiophenone) with benzalacetophenone and of acetophenone with benzalpropiophenone.” By R. D. Abell.

Phenyl ethyl ketone and benzalacetophenone condense under the influence of sodium ethoxide to form: (i) 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ (prisms, m. p. 103·5—104·5°); (ii) 2 : 4-diphenyl-1-methyl-1 : 3 : 5-tribenzoylpentane, $C_{39}H_{34}O_3$ (rhombic plates, m. p. 241—242°).

The former substance reacts with hydroxylamine to form a *dioxime*, $C_{24}H_{24}N_2O_2$ (needles, m. p. 204—205°), and with hydroxylamine hydrochloride to form 2 : 4 : 6-*triphenyl 3-methylpyridine*, $C_{24}H_{19}N$ (needles, m. p. 141—142°), this base yielding a *picrate* (yellow prisms, m. p. 190—191°) and a *hydrochloride* in colourless, hygroscopic needles.

Acetophenone and benzalpropiophenone in presence of sodium ethoxide react to form: (i) 2-phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (six-sided crystals, m. p. 162—163°. *Trans.*, 1901, **79**, 936); (ii) a mixture of 2-phenyl-1 : 3-dibenzoylpropane, $C_{23}H_{20}O_2$ (Kostanecki and Rossbach, *Ber.*, 1896, **29**, 1492), and 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ crystallising in prisms melting at 93—94°; (iii) 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ (prisms, m. p. 103·5—104·5°); (iv) 2 : 4-diphenyl-1-methyl-1 : 3 : 5-tribenzoylpentane, $C_{39}H_{34}O_3$ (rhombic plates, m. p. 241—242°); (v) 2 : 4-diphenyl-1 : 3 : 5-tribenzoylpentane, $C_{38}H_{32}O_{31}$ (glistening prisms, m. p. 255—256°) (Kostanecki and Rossbach, *Ber.*, 1896, **29**, 1492); (vi) benzoic acid; (vii) a pink, viscid, acid liquid.

The two homologous 1 : 5-diketones indicated under (ii) could not be separated by solvents, but were identified by means of the corresponding dioximes and pyridines, namely: the dioxime, $C_{23}H_{22}N_2O_2$ (needles, m. p. 163—164°), and 2 : 4 : 6-triphenylpyridine, $C_{23}H_{17}N$ (needles, m. p. 137—138°: Wislicenus and Newman, *Annalen*, 1898, **302**, 236), corresponding to 2-phenyl-1 : 3-dibenzoylpropane, and the dioxime, $C_{24}H_{24}N_2O_2$ (needles, m. p. 204—205°) and 2 : 4 : 6-triphenyl-3-methylpyridine, $C_{24}H_{19}N$ (needles, m. p. 141—142°), corresponding to 2-phenyl-1-methyl-1 : 3-dibenzoylpropane.

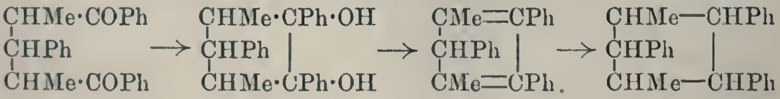
In presence of an alcoholic solution of sodium hydroxide, acetophenone and benzalpropiophenone reacted to form: (i) 2-phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (six-sided crystals, m. p. 162—163°); (ii) the mixture of homologous 1 : 5-diketones (prisms, m. p. 93—94°).

It is therefore evident that the reaction between acetophenone and benzalpropiophenone is not a condensation in the true sense of the word, and that the substances isolated are formed by the condensation of the decomposition products of benzalpropiophenone (phenyl ethyl ketone and benzaldehyde) with benzalpropiophenone and acetophenone.

11. "A synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane." By R. D. Abell.

2-Phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (*Trans.*, 1901, **79**, 936), when reduced by zinc dust and acetic acid, yielded the cyclic pinacone 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentandiol, $C_{25}H_{26}O_2$ (prisms, m. p. 143—144°), and this on reduction with red phosphorus and hydriodic acid gave two isomeric 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentanes, $C_{25}H_{26}$, the one crystallising in needles, m. p. 80—81°, the other being a yellow oil (b. p. 246—248°, 25 mm.).

When fused with oxalic acid, the pinacone loses two molecules of water (Fischer, *Ber.*, 1897, **30**, 559) to form the unsaturated hydrocarbon, 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentadiene, $C_{25}H_{22}$ (needles, m. p. 127—128°), which, on reduction with red phosphorus and hydriodic acid, also gave both saturated hydrocarbons.



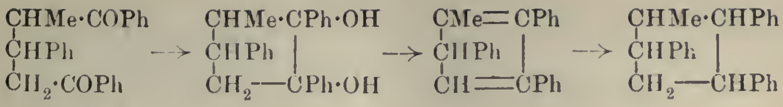
$$\begin{array}{l} \mathrm{CHMe{\cdot}COPh} \\ | \\ \mathrm{CHPh} \\ | \\ \mathrm{CHMe{\cdot}COPh} \end{array} \longrightarrow \begin{array}{l} \mathrm{CHMe{\cdot}CPh{\cdot}OH} \\ | \qquad\qquad | \\ \mathrm{CHPh} \qquad | \\ | \qquad\qquad | \\ \mathrm{CHMe{\cdot}CPh{\cdot}OH} \end{array} \longrightarrow \begin{array}{l} \mathrm{CMe{=}CPh} \\ | \qquad\ \ | \\ \mathrm{CHPh} \ \ | \\ | \qquad\ \ | \\ \mathrm{CMe{=}CPh.} \end{array} \longrightarrow \begin{array}{l} \mathrm{CHMe{-}CHPh} \\ | \qquad\qquad | \\ \mathrm{CHPh} \qquad | \\ | \qquad\qquad | \\ \mathrm{CHMe{-}CHPh} \end{array}$$

2-Phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$, on reduction with zinc dust and acetic acid gave: (i) 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentandiol, $C_{24}H_{24}O_2$; (ii) 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentadiene, $C_{24}H_{20}$; the former is a brown oil crystallising with difficulty, the latter, which is probably due to the dehydration of the cyclic pinacone by acetic acid, forms yellow needles and melts at 162—163°.

The cyclic pinacone, $C_{24}H_{24}O_2$, obtained as an almost colourless oil by reducing the 1 : 5-diketone with sodium amalgam in moist ethereal solution, solidified in needles (m. p. 68—80°) when left in a vacuum over concentrated sulphuric acid, but could not be recrystallised from solvents as it always separated as an oil.

The cyclic pinacone, when fused with oxalic acid, gave the unsaturated hydrocarbon, 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentadiene, $C_{24}H_{20}$ (yellow needles, m. p. 162—163°).

Both the pinacone and the unsaturated hydrocarbon gave two isomeric 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentanes, $C_{24}H_{22}$, on reduction with red phosphorus and hydriodic acid, the one crystallising in needles (m. p. 121—122°), the other being a yellow oil (b. p. 260—262°, 28 mm.).



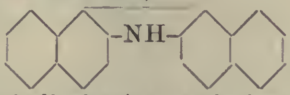
$$\begin{array}{l}\text{CHMe}\cdot\text{COPh}\\ \text{CHPh}\\ \text{CH}_2\cdot\text{COPh}\end{array} \longrightarrow \begin{array}{l}\text{CHMe}\cdot\text{CPh}\cdot\text{OH}\\ \text{CHPh}\ \ |\\ \text{CH}_2\text{---CPh}\cdot\text{OH}\end{array} \longrightarrow \begin{array}{l}\text{CMe}=\text{CPh}\\ \text{CHPh}\ \ |\\ \text{CH}=\text{CPh}\end{array} \longrightarrow \begin{array}{l}\text{CHMe}\cdot\text{CHPh}\\ \text{CHPh}\ \ |\\ \text{CH}_2\text{---CHPh}\end{array}$$

12. "**Formation of carbazoles by the interaction of phenols, in the orthoketonic form, with arylhydrazines.**" By **F. R. Japp** and **W. Maitland.**

In a preliminary note (*Proc.*, 1901, **17**, 176) the authors showed that carbazoles could be obtained by heating certain phenols with arylhydrazines in presence of their hydrochlorides. They now find that the ease with which this reaction occurs is proportional to the readiness with which the phenol in question passes into the tautomeric orthoketonic form. Thus phenol itself does not yield any carbazole under the foregoing conditions; α-naphthol reacts, but with great difficulty, giving a very poor yield of the carbazole derivative; β-naphthol and 9-hydroxyphenanthrene react with relative ease. This is precisely the order of reactivity in the orthoketonic form, which Thiele's theory of double linkings would, in its application to benzene derivatives, predict for these phenols.

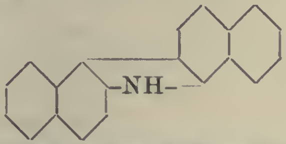
In addition to the carbazoles described in the preliminary note, the following have been prepared. The nomenclature adopted is that proposed by Graebe (*Ber.*, 1894, **27**, 3066).

s-1 : 2-*Dinaphthocarbazole*,



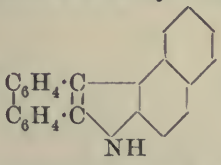
(m. p. 155°).—From β-naphthol, β-naphthylhydrazine and its hydrochloride; identical with "dinaphthyleneamine," which Walder (*Ber.*, 1882, **15**, 2173) obtained by heating ββ-dinaphthol with the double compound of zinc chloride and ammonia.

1 : 2 : 2′ : 1′-*Dinaphthocarbazole*,

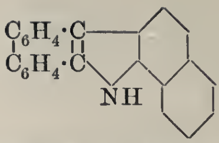


(m. p. 231°).—From β-naphthol, α-naphthylhydrazine and its hydrochloride.

9 : 10-*Phenanthro*-1′ : 2′-*naphthocarbazole*,

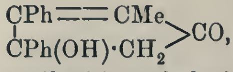


(m. p. 220°).—From 9-hydroxyphenanthrene, β-naphthylhydrazine and its hydrochloride.

9 : 10-*Phenanthro*-2′ : 1′-*naphthocarbazole*,  (m. p. 225·5°).—From 9-hydroxyphenanthrene, α-naphthylhydrazine, and its hydrochloride.

In their first note on this subject (*loc. cit.*) the authors pointed out that 1 : 2-naphthocarbazole (phenyl-2-naphthylcarbazole), first prepared by Schöpff (*Ber.*, 1896, **29**, 269), melted at 134—135°, instead of, as stated by that investigator, at 120°. They had overlooked the fact that this correction had already been made by F. Ullmann (*Ber.*, 1898, **31**, 1697).

13. "Dimorphism of α-methylanhydracetonebenzil." By F. R. Japp and A. C. Michie.

α-Methylanhydracetonebenzil,  $\begin{matrix} CPh{=\!=}CMe \\ CPh(OH){\cdot}CH_2 \end{matrix}\!>\!CO$, which is best obtained by the condensation of benzil with methyl ethyl ketone under the influence of a 0·5 per cent. solution of potassium hydroxide in absolute alcohol, was described by Japp and Meldrum (*Trans.*, 1901, **79**, 1029) as forming large, flat crystals of rhombic outline ("lozenge-shaped") melting at 118°. These crystals show oblique extinction in polarised light.

The authors prepared this compound on various occasions and were able to confirm the foregoing observations. About a year ago, however, although working under apparently the same conditions, they obtained a substance crystallising in octahedra which were isotropic in polarised light and melted at 133·5°. Analysis showed that this substance had the same composition as α-methylanhydracetonebenzil.

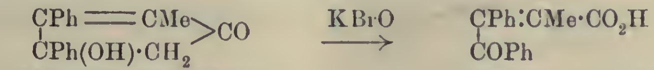
Further investigation has demonstrated that these two substances, which the authors at first supposed to be distinct chemical compounds, are, in reality, merely dimorphous forms of α-methylanhydracetonebenzil. The difficulty in proving this lay in the fact that, after the second form had once been obtained, it was apparently impossible again to prepare the first form. At last, however, the authors succeeded in doing this, but they were quite unable to obtain the result a second time; moreover, the substance was so unstable that it was converted, even in determining its melting point, into the less fusible form.

The authors wish to call attention to this dimorphism, as other investigators, who might happen to obtain the more stable form first, would probably fail to recognise the substance as chemically identical with that formerly described (*Trans.*, *ibid.*).

14. "The oxidation products of the methyl homologues of anhydracetonebenzil." By F. R. Japp and A. C. Michie.

The various methyl homologues of anhydracetonebenzil were described by Japp and Meldrum (*Trans.*, 1901, 79, 1028, 1036, and 1037). The present authors have studied the oxidation of these substances, with the exception of αββ-trimethylanhydracetonebenzil, which, owing to the difficulty of preparing it, was not included in the investigation.

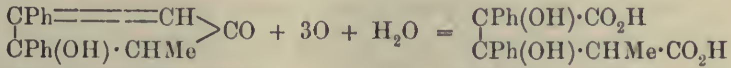
Of the four methyl homologues examined, only α-methylanhydracetonebenzil is attacked by alkaline hypobromite:



$$\begin{matrix}CPh{=\!=}CMe\\ |\qquad\quad\\ CPh(OH)\cdot CH_2\end{matrix}\!>\!CO \xrightarrow{KBrO} \begin{matrix}CPh{:}CMe\cdot CO_2H\\ |\qquad\quad\\ COPh\end{matrix}$$

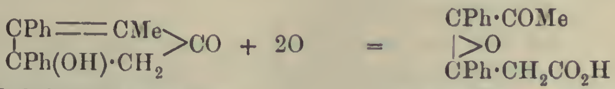
α-Methylanhydracetonebenzil (m. p. 118° and 133·5°). α-Desylenepropionic acid (m. p. 174·5°).

All four homologues are, however, readily oxidised by chromium trioxide in acetic acid solution:

I. 

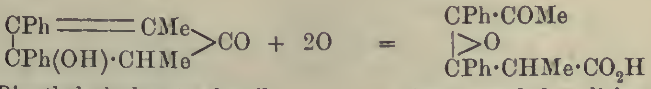
$$\begin{matrix}CPh{=\!=}CH\\ |\qquad\quad\\ CPh(OH)\cdot CHMe\end{matrix}\!>\!CO + 3O + H_2O = \begin{matrix}CPh(OH)\cdot CO_2H\\ |\qquad\quad\\ CPh(OH)\cdot CHMe\cdot CO_2H\end{matrix}$$

β-Methylanhydracetonebenzil (m. p. 180°). α-Methyl-α′β-diphenyl-α′β-dihydroxyglutaric acid (m. p. 176°, with decomposition).

II. 

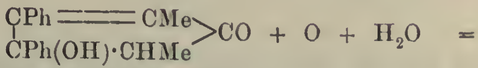
$$\begin{matrix}CPh{=\!=}CMe\\ |\qquad\quad\\ CPh(OH)\cdot CH_2\end{matrix}\!>\!CO + 2O = \begin{matrix}CPh\cdot COMe\\ |\!>\!O\\ CPh\cdot CH_2CO_2H\end{matrix}$$

α-Methylanhydracetonebenzil (m. p. 118° and 133·5). γ-Aceto-βγ-diphenyl-βγ-oxidobutyric acid (m. p. 131—132°).

IIIa. 

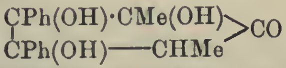
$$\begin{matrix}CPh{=\!=}CMe\\ |\qquad\quad\\ CPh(OH)\cdot CHMe\end{matrix}\!>\!CO + 2O = \begin{matrix}CPh\cdot COMe\\ |\!>\!O\\ CPh\cdot CHMe\cdot CO_2H\end{matrix}$$

αβ-Dimethylanhydracetonebenzil (m. p. 150°). γ-Aceto-α-methyl-βγ-diphenyl-βγ-oxidobutyric acid (m. p. 164°, with decomposition).

IIIb. 

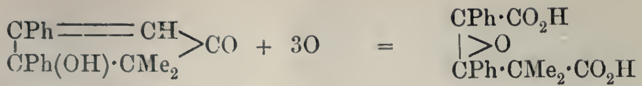
$$\begin{matrix}CPh{=\!=}CMe\\ |\qquad\quad\\ CPh(OH)\cdot CHMe\end{matrix}\!>\!CO + O + H_2O =$$

αβ-Dimethylanhydracetonebenzil.



$$\begin{matrix}CPh(OH)\cdot CMe(OH)\\ |\qquad\quad\\ CPh(OH){-\!-}CHMe\end{matrix}\!>\!CO$$

1 : 3-Dimethyl-4 : 5-diphenyl-1 : 4 : 5-trihydroxy*cyclo*pentanone-(2) (m. p. 89°).

IV. 

$$\begin{array}{l}\mathrm{CPh}{=\!=\!=}\mathrm{CH} \\ \mathrm{CPh(OH)\cdot CMe_2}\end{array}\!\!>\mathrm{CO} + 3\mathrm{O} = \begin{array}{l}\mathrm{CPh\cdot CO_2H}\\ |\!>\mathrm{O}\\ \mathrm{CPh\cdot CMe_2\cdot CO_2H}\end{array}$$

ββ-Dimethylanhydracetonebenzil (m. p. 181°).

αα-Dimethyl-α′β-diphenyl-α′β-oxidoglutaric acid (m. p. 171° and 184°).

The authors suggest the use of the prefix "oxido" to denote "bridge-oxygen" regarded as a bivalent substituent.

15. "Action of hypobromites on amides." By A. Lapworth and W. W. S. Nicholls.

The action of hypobromites on certain amides has been carefully studied with the idea that the change might depend on the formation, at an intermediate stage, of alkyl and cyanate ions, which would subsequently unite to form an alkyl carbimide, as indicated in the following equations:

$$\mathrm{CH_3\cdot CO\cdot NH_2} + \mathrm{Br_2} = \overset{+}{\mathrm{CH_3}} + \overset{-}{\mathrm{CNO}} + 2\mathrm{HBr},$$

$$\overset{+}{\mathrm{CH_3}} + \overset{-}{\mathrm{CNO}} = \mathrm{CH_3\cdot N{:}C{:}O}.$$

In endeavouring to imitate the conditions supposed to obtain during the reaction, potassium cyanate was warmed with potassium methyl sulphate in alkaline solution; methylamine was easily isolated, but in comparatively small amount. It is well known that phenylcarbimide is formed when nascent phenyl groups (ions?) are produced in presence of potassium cyanate, as when benzenediazonium salts are decomposed by copper powder.

An examination was made of the bye-products in the preparation of methylamine from acetamide and of aniline from benzamide, particular attention being paid to the possibility of methyl alcohol and phenol or their decomposition products being formed, but no direct evidence bearing on the point was obtained. From benzamide, under these conditions, benzylidenedibenzamide, $\mathrm{CHPh(NHCOPh)_2}$, is almost invariably obtained. This is probably not produced from benzaldehyde formed at an intermediate stage, as the aldehyde does not condense with benzamide under the experimental conditions.

16. "Derivatives of menthyl cyanoacetate." By D. A. Bowack and A. Lapworth.

A recent abstract (1903, 84, ii, 2) of a paper by Tschugaeff (*J. Russ. Phys. Chem. Soc.*, 1902, 34, 606—622) contains a reference to the optical rotation of menthyl cyanoacetate. As the authors have had this compound and some of its derivatives under examination for several months, they wish to record certain of their observations.

Menthyl cyanoacetate, $CN{\cdot}CH_2{\cdot}CO_2{\cdot}C_{10}H_{19}$, prepared by heating the ethyl ester with menthol, crystallises in well-formed, flattened needles melting at 83—84°. In 2 per cent. solution in benzene, it had $[\alpha]_D^t = -81{\cdot}12°$ (Tschugaeff gives $-80{\cdot}71°$) and no mutarotation could be detected. The *monobromo*-derivative, $CN{\cdot}CHBr{\cdot}CO_2{\cdot}C_{10}H_{19}$, crystallises in long needles and melts at 134—135°.

Menthyl p-*tolylazocyanoacetate*, $C_6H_4Me{\cdot}N_2{\cdot}CH(CN){\cdot}CO_2{\cdot}C_{10}H_{19}$, crystallises in large, transparent, yellow plates melting at 93—95°; it has $[\alpha]_D = -53{\cdot}7°$ in benzene and does not exhibit mutarotation.

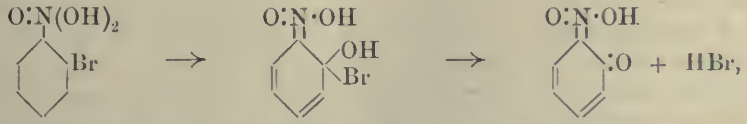
Menthyl p-*bromophenylazocyanoacetate*,

$$C_6H_4Br{\cdot}N_2{\cdot}CH(CN){\cdot}CO_2{\cdot}C_{10}H_{19},$$

has been obtained in two forms, one crystallising in transparent plates melting at 97—98°, and the other in slender needles having a somewhat indefinite melting point.

17. "The influence of nitro-groups on the reactivity of halogen derivatives of benzene." By A. Lapworth.

Four years ago, the reactivity of the halogen atoms in the *ortho*- and *para*-halogenated nitrobenzenes was discussed on the assumption that an addition product, formed by adding the elements of water or another agent to the nitro-group, underwent change in the following way:



this reaction being impossible when the halogen is in the *meta*-position (Lapworth and Mills, *Proc.*, 1898, 14, 159).

This explanation, which was put forward at a time when the part played by quinonoid intermediate compounds in conditioning analogous changes was not generally recognised, is revived because other reactions of this type are now being explained on similar lines.

ADDITIONS TO THE LIBRARY.

I. Donations.

Dibdin, William Joseph. Public lighting by gas and electricity. pp. xx, 537, ill. London 1902. From the Author.

Lehfeldt, Robert A. A text-book of physics: with sections on the application of physics to physiology and medicine. pp. viii, 304, ill. London [1902]. From the Author.

Mayow, John. Untersuchungen über den Salpeter und den salpetrigen Luftgeist, das Brennen und das Athmen. Herausgegeben von F. G. Donnan. (*Being No.* 125 *of Ostwald's Klassiker.*) From the Editor.

II. Pamphlets.

Ackroyd, William. On the circulation of salt and its bearing on geological problems, more particularly that of the geological age of the earth. (*From the Proc. Yorks. Geol. Poly. Soc.* 1902.)

Albo, Giacomo. Alcune considerazioni sul significato fisiologico degli alcaloidi vegetali. (*From the Nuovo giorn. bot. ital.* 1902.)

Bellati, M., and Finazzi, L. Sul calore che si produce bagnando le polveri. (*From the Atti. R. Inst. Veneto.* 1902.)

Harper, Henry Winston. A contribution to the chemistry of some of the asphalt rocks found in Texas. Austin, Texas, 1902.

Hebb, Thomas C. On a determination of the freezing-point depression constant for electrolytes. (*From the Trans. Nov. Scot. Inst. Sc.* 1902.)

Herrera, A. L. Le protoplasma de métaphosphate de chaux. Mexico 1902.

Kinch, Edward. Manurial experiments on permanent grass at the Royal Agricultural College, Cirencester. (*From the Agricultural Students' Gazette,* Dec. 1902.)

Storer, Francis Humphreys. Testing for mannose. (*From the Bulletin of the Bussey Institution* 1902.)

At the next ordinary meeting, on **Thursday**, February 5th, 1903, at **8** p.m., the following papers will be communicated:

"A new vapour-density apparatus." By J. S. Lumsden, D.Sc.

"A new principle for the construction of a pyrometer." By J. S. Lumsden, D.Sc.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 18th, 1903.

Alderton, Gilbert John,

"The Nest," Eglinton Road, Plumstead, London, S.E.

Student. Educated at King's College School and King's College, London. Obtained Mathematical Scholarship at King's College School, also Intermediate and Senior London County Council Scholarships. Honours Chemistry at Intermediate B.Sc. (Lond.). Daniell Scholarship for Chemical Research, King's College, London. Associate of Institute of Chemistry.

John M. Thomson.	D. Northall Laurie.
Herbert Jackson.	Fred. Carrodus.
Patrick H. Kirkaldy.	*W. D. Halliburton.*

Appleyard, George Henry,

151, Cleveland Street, Hull.

Analytical and Consulting Chemist. 3½ Years Student at the Yorkshire College, Leeds; 3½ years with Alfred H. Allen, Esq., West Riding of Yorkshire County Analyst, Sheffield. At present Analytical and Consulting Chemist to the British Oil and Cake Mills, Ltd., Hull, Fellow of the Institute of Chemistry.

Alfred H. Allen.
Arthur Smithells.
G. E. Scott-Smith.
Herbert Ingle.
Julius B. Cohen.
Wyndham R. Dunstan.
Otto Hehner.

Atkinson, Edwin Bayles,

Scartho House, Gt. Grimsby.

Science Teacher. 1. Recognised by Board of Education as Teacher of Chemistry and Physics. 2. Late Demonstrator at Westminster School. 3. Undergraduate of London University. 4. Now Science Master at Gillingham (Dorset) Gram. School (Organised Science School).

Charles H. Bothamley.
H. Brereton Baker.
H. E. Hadley.
Otto C. J. G. L. Overbeck.
E. H. Winder.
Willie Briggs.
Alex. H. Bennett.

Bowen, William,

Clevedon, Woodend Road, Erdington.

Works Chemist. Have been Chemist at the Nickel Companies' Erdington Works the last four years; before then was a student at the Mason College for 4 sessions. I am an Associate of the Institute of Chemistry.

J. McCrae.
T. Slater Price.
Andrew Turnbull.
Percy F. Frankland.
C. F. Baker.
Cecil Leigh.

Bradbury, Samuel,

Thornham New Road, Castleton, Lancs.

Technical Chemist. Head Chemist for five years with Gartside et Cie., Malaunay, Seine Infre., France. Assistant to M. Horace Koechlin, Rouen (Founder of the *Revue Générale des Matières Colorantes*), to which journal contributed a "Note sur le danger du Chlorate et du Sulfocyanure" (June, 1897), also technical articles in the U.S. *Textile World* (August and September, 1897) and the Eng. *Textile Manufacturer* (September and October, 1897) on "The Printing of Metallic Powders on Calico." At present engaged on Research work under Prof. W. H. Perkin, jun., at Owens College.

H. B. Dixon.
Wm. A. Bone.
W. H. Perkin, jun.
D. L. Chapman.
J. Carter Bell.

Branch, George Thomas,

c/o Mr. G. Darroll, Harfield, Claremont, Cape Town, S. Africa.

Assayer and Chemist. Chemist and Druggist, Pharmaceutical Soc. of Great Britain. For 6 years Demonstrator in Practical Chemistry and Lecturer in Materia Medica and General Analytical work at Metropolitan College of Pharmacy, 160—162, Kennington Park Road, London. Joint Author on "Kino," published in *Chemist and Druggist*, Ap. 1898. Author of paper on "Rubber," published in *Pharmaceutical Journal*, and read before the Cape Pharmaceutical Society, Dec. 1900. Author of paper on "Ricinus species," 1902. Herbarium Medallist, Pharm. Soc. of G.B., 1892.

M. M. Pattison Muir.
R. S. Morrell.
S. Ruhemann.
W. Watson Will.
Peter MacEwan.
Thos. Tyrer.

Bywaters, Hubert William,

11, King Street, Regent Street, London, W.

Associate of the Royal College of Science, London [1900], Ph.D. (Würzburg), 1902. Engaged in Research in collaboration with Prof. Dr. W. Wislicenus (Tübingen Universität). Desirous of obtaining best current chemical literature and use of Reference Library.

M. O. Forster.
G. T. Morgan.
James C. Philip.
H. Burrows.
James D. Kettle.

Cadman, William Henry,

Lord Williams's Grammar School, Thame, Oxon.

Science Master. Candidate has passed the Final B.Sc. degree (Wales) examinations in Inorganic and Organic Chemistry after studying at the Univ. College of N. Wales, Bangor, under Prof. James J. Dobbie, M.A., D.Sc., F.C.S.

R. Hornby.
Alexander Lauder.
Percy Elford.
W. A. Lethbridge.
W. T. B. Ridge.
James Robson.

Castell-Evans, John,

141, Ferme Park Road, Crouch End, N.

Senior Demonstrator in the Chemical Department of the City and Guilds' Technical College, Finsbury. Studied under the late Sir Edward Frankland, afterwards acted as Demonstrator under him. Since 1880, have been in my present position, lecturing on Chemistry, Metallurgy, &c. Author of "Experimental Chemistry," "Key and Companion to Experimental Chemistry," "Physico-chemical Tables," &c.

Raphael Meldola. Lewis Eynon.
F. Southerden. B. E. R. Newlands.
Arthur R. Ling.

Codling, Arthur John,

5, Tavistock Square, London, W.C.

Analytical Chemist. Assistant to Dr. Augustus Voelcker & Sons. Late Assistant to Francis Sutton, Esq., F.C.S., F.I.C., of Norwich.

J. Augustus Voelcker. Harry M. Freear.
E. W. Voelcker. Thos. Howard.
Francis Sutton.

Cousins, Francis George,

Stanley House, 56, Queen's Road, London, N.

Science Master. Educated at City of London School. Late Chemical Student at the City and Guilds Technical College, Finsbury, under Prof. R. Meldola, F.R.S. Science Master at the College, Beccles, Suffolk. Late Science Master, Andover Grammar School.

R. Meldola. W. A. Handcock.
F. Southerden. *R. C. T. Evans.*
J. B. Knight.

Coyle, Benjamin Claxton,

City Laboratory, 17, Castle Street, Dublin, and 65, Lansdowne Road, Dublin.

Chemical Analyst. Assistant to Sir Charles A. Cameron, C.B., M.D., F.R.C.S.I. I studied for 2½ years under Professor J. Emerson Reynolds, F.R.S., at the University of Dublin, both Inorganic and Organic Chemistry. I have been assistant to Sir Charles A. Cameron, C.B., M.D., &c., Public Analyst, for nearly twelve years, both in the Laboratory and at his Lectures at the Royal College of Surgeons.

Julius Ostersetzer. J. Emerson Reynolds.
E. S. Cameron. Ch. R. C. Tichborne.
Emil A. Werner. *W. E. Adeney.*

Desch, Cecil Henry,

Instow, Mount Pleasant Road, South Tottenham, London, N.

Assistant to Prof. A. K. Huntington, Metallurgical Laboratory, King's College, W.C. Studied 1889—1892 at Technical College, Finsbury. From 1892—1900, Chemist to Messrs. F. Kendall and Son, Stratford-on-Avon. Passed Institute of Chemistry examination in 1895, and London B.Sc., with 1st Class Honours in Chemistry, same year. Worked 1900—1902 at Würzburg University under Prof. Hantzsch, and obtained degree of Ph.D. summa cum laude. Obtained London D.Sc., 1902. Papers, Meldola and Desch, "Naphthalene Derivs.," Trans., 1892, 765; Hantzsch and Desch, "Organische Ferriverbindungen," *Lieb. Ann.*, **323**, 1.

A. K. Huntington.	R. Meldola.
William Ramsay.	Morris W. Travers.

R. C. T. Evans.

Elford, Archibald Sefton,
9, Keble Road, Oxford.

Obtained Honours in Natural Science (Chemistry) at Oxford in the Final Examination. Has since studied food and drug analysis.

H. Macan.	John Watts.
V. H. Veley.	J. E. Marsh.
W. W. Fisher.	P. Elford.

Farmer, Robert Crosbie,
154, Eglinton Road, Woolwich.

Chemical Assistant in Research Dept. of Royal Arsenal, Woolwich. M.Sc. (Victoria), Ph.D. (Würzburg). Contributions to chemical science as follows: "Die Constitution der sogen. Oxyazokörper," *Ber.*, **32**, 3081; "α-Oximidoketone und Chinonoxime als Pseudosäuren," *Ber.*, **32**, 3101; "Hydrolyse von Natriumphenolaten," see *Ber.*, **32**, 3080 (the above were done in collaboration with Prof. Hantzsch); "Liquid Nitrogen Peroxide as a Solvent," Trans., **79**, 1356 (with Prof. Frankland); "A new method for the determination of hydrolytic dissociation," Trans., **79**, 863. For some time I was a demonstrator at Birmingham University.

Percy F. Frankland.	Thomas H. Pope.
T. Slater Price.	Adrian J. Brown.
Alex. McKenzie.	O. Silberrad.

Hindmarsh, Leonard King,
354, Lordship Lane, S.E.

B.A. Balliol College, Oxford 2nd class Natural Science, 1900. Chemistry Master, Alleyn's School, Dulwich.

H. Brereton Baker.	Allen F. Walden.
D. H. Nagel.	*N. V. Sidgwick.*
Harold Hartley.	*R. T. Lattey.*

Howorth, Franklin Wise,

Rose Bank, Elmdale Road, Palmer's Green, N.

Technical Chemist. Associate of the Chartered Institute of Patent Agents. Twelve years with Robt. Rumney, Manufg. Chemist, Ardwick, Manchester. Part of time superintended various manufactures, including Acetate of Iron, Nitrates of Iron and Copper, Acetic Acid, Wood Spirit, Verdigris, Chromium Acetate, Manganese Sulphate, Nitric Acid, Cylinder Hydrochloric Acid, Stannate of Soda, and Tin Salts generally. Glauber's Salts, Caustic Potash, and soluble Alkaline Silicates. Nearly two years Chemist to the late J. H. Parkinson, Compressed Gas Engineer, Stratford, Lancashire. There I conducted experiments in oxygen manufacture. Now and for past seven years advising Chemist to Mr. W. Lloyd Wise, C.P.A. Hold 1st class certificates Owens College (Evening), 1st, 2nd, and 3rd years' lecture course, and 2nd year's laboratory course.

Otto Hehner.
C. C. Hutchinson.
Oscar Guttmann.
B. E. R. Newlands.
F. Napier Sutton.
Watson Smith.
Thomas Tyrer.

Huyin, Moung Tha, B.A., (Cal.), M.R.A.S.,

"Burma," 18, Mercers Road, London, N.

Student member, Lincoln's Inn. Passed in Chemistry, Calcutta, B.A., Examination, 1898.

Thomas Wardle.
Gerald T. Moody.
William A. Davis.
Edward W. Lewis.
R. Steele.
J. Carter Bell.
Harold Hartley.

Kemp-Welch, Maurice,

Parkstone, Weybridge, Surrey.

Graduate of Cambridge University. Natural Science Tripos, Part I (2nd). Late Hon. Exhibitioner King's College, Cambridge.

W. J. Sell.
H. O. Jones.
Charles T. Heycock.
Jas. Kewley.
Thos. R. Duggan.

Lees, Frederic Herbert,

256, Park Road, Crouch End, London, N.

Research Chemist in the Wellcome Chemical Research Laboratories. Studied Chemistry at the Owens College, Manchester, where I subsequently, and for two years, held the post of Private Assistant to Prof. W. H. Perkin. Have contributed several papers to the Society's Transactions.

H. B. Dixon.
Wm. A. Bone.
W. H. Perkin, jun.
G. H. Bailey.
F. B. Power.

Leigh, Arthur Graham,

Chorcliff House, Chorley, Lancs.

Rivers Inspector. Served for six years and over as assistant inspector to the Ribble Joint Committee. During that time he underwent a chemical training in the Committee's Laboratory at Preston, and has had experience in the analysis of water, sewage, trades waste, &c., and has assisted in the various chemical investigations published from that laboratory.

Wm. Naylor.
Jno. T. Brierley.
Wm. Jas. Orsman.
Arthur Smithells.
Julius B. Cohen.

Lewis, Harry Percy,

Hematite House, Swansea Hematite Iron and Steel Works,
Landore, R.S.O., South Wales.

Head Chemist and Assistant Works Manager. During the years 1889 and 1890, I successfully passed the following South Kensington examinations. Honours Practical Inorganic Chemistry, Advanced Theoretical Inorganic Chemistry, the elementary Stages of Practical and Theoretical Organic Chemistry and Machine Drawing. I have also had the management of the Laboratory and other departments at the above Works for the last 14 years.

Frank B. Last.
Thomas Sandford.
Rhys P. Charles.
Herbert Eccles.
Charles Crocker.

Mander, Percy George,

Spon House, Spon End, Coventry.

Science Master, Grammar School, Ashby-de-la-Zouche. B.Sc., Lond. First Class Chem. Hon. Royal Coll. Sci., Lond. First Class, third year chem. R.C.S., Lond., one year; Mason Univ. Coll., Birmingham, three years.

Percy F. Frankland.
M. O. Forster.
William A. Tilden.
G. T. Morgan.
James C. Philip.

O'Brien, Frederick,

15, Lilymead Avenue, Knowle, Bristol.

Analytical Chemist. 1896—1899, Studied Chemistry at University College, Liverpool. Took degree of B.Sc. Honours in Chemistry, Victoria University, 1899. Proceeded to M.Sc. Degree in 1902. For about 18 months in Laboratory of Public Analyst for the City of Liverpool and County of Lancaster. From Jan., 1901, to present time, Chemist to the Western Tanning Co., Bedminster, Bristol.

J. Campbell Brown. Charles A. Kohn.
W. Collingwood Williams. Ernest Bowman Ludlam.
Sydney Young.

Samuel, Thomas,

School of Science and Art, Liscard, Cheshire.

Organising Secretary to the Technical Instruction Committee of the Wallasey Urban District Council. Teacher of Chemistry in Public Secondary Schools and, since July, 1897, Director of all Science and Technical Classes in the Wallasey District (population 55,000), B.A., Inter. B.Sc. (London).

J. Parry Laws. R. Henry Jones.
Charles J. Mansford. *F. H. Tate.*
Edward Davies.

Scholefield, Alfred Henry,

4, Hartley Terrace, Wolverhampton.

Schoolmaster. Science Master, Wolverhampton Grammar School. B.A., B.Sc., London University.

J. H. Hichens. Frank Brownsword.
J. T. Dunn. Wm. Whitehouse.
W. H. C. Jemmett. A. E. Dunstan.

Sibley, Samuel Edward,

3, Rutland Road, Ilford.

Technical Chemist. Have occupied position as deputy manager, Messrs. A. Boake, Roberts & Co., Manufacturing Chemists, Stratford, and as head assistant in their laby. under W. B. Giles, F.I.C.

R. Meldola. T. FitzGibbon.
F. Southerden. *E. Haynes Jeffers.*
Geo. Patterson.

Steven, Alec Bowring,

Ness House, Surbiton, Surrey.

Assistant Lecturer on Dyeing at the Yorkshire College, Leeds. B.Sc., London. Six years at University College. Joint author with Mr. A. G. Perkin of "Purpurogallin. I.," in *Journal*, 1903.

A. G. Perkin. H. M. Dawson.
William Ramsay. Morris W. Travers.
A. G. Green.

Thomson, George Malcolm,

Newington, Dunedin, N.Z.

Science Teacher. Have been teaching Chemistry in the Otago High Schools for over twenty years. Examiner in the University, &c.

John R. Don. O. Gore Adams.
Thomas H. Easterfield. A. Liversidge.
B. C. Aston. *J. S. Maclaurin.*

Tilburn, Charles,

31, Hardy Street, South Yarra, Melbourne, Victoria.

Assistant Lecturer in Chemistry, Geology, and Mineralogy, School of Mines, Stawell, Victoria. Passed Victorian Departmental Examinations in Metallurgy and Chemistry courses; lately Assistant Demonstrator in Chemistry, Working Men's College, Melbourne; Lecturer, Chemistry, &c., School of Mines, Stawell.

D. Avery. Orme Masson.
A. W. Craig. *Fred. W. Steel.*
Henry C. Jenkins.

Tolson, Stanley,

14, Furnivall Road, Balby, Doncaster.

Analytical Chemist. Assistant to the Great Northern Railway Co.'s Analyst. Two years student at the Yorkshire College, Leeds (Organic and Inorganic Chemistry, Physics and Dyeing). One year with Messrs. Read, Holliday & Sons, Ltd., Huddersfield, as Chemist (Chemical and Aniline Dye Manufacturers). One year in the Chemical Institute of Herr Gehr. Prof. Dr. Emil Fischer (Berlin University). Joint author with Dr. Otto Diels, "Ueber die Nitrirung des 2-Aminofluorens," published in the *Berichte*, August, 1902. Completed nine months with G.N.R. Analyst, and still there doing general chemical analysis.

Arthur Smithells. Emil Fischer.
Julius B. Cohen. Walter Leach.
John K. S. Dixon.

Toyne, Francis Digby,

Santubong, Saräwak.

Chemist, c/o Messrs. Saräwak Cutch Co. Ltd., Santubong, Saräwak. Training acquired at the Yorkshire College, Leeds, in the Dyeing and Chemistry Departments; also in Germany at Messrs. Bayer's of Elberfeld. Associate of the Society of Dyers and Colourists. Honours in City and Guilds Examination in Dyeing and for 2 years in charge of the Laboratory, Saräwak Cutch Company, Ltd., &c.

Henry R. Procter. Arthur Smithells.
Andrew Turnbull. E. J. Wilkinson.
S. Arch. Vasey.

Turner, Duncan,

Elmbank, Broomhouse, By Glasgow.

Assistant Lecturer on Chemistry and Metallurgy. Received training under Prof. Watson, Anderson's College, Glasgow. For three years Assistant in the Chemical and Metallurgical Laboratory of Coatbridge Technical School and Mining College.

James McCutcheon. R. R. Tatlock.
Andrew Turnbull. H. Procter Smith.
Geo. Ritchie.

Wadmore, John Mello, B.A. (Oxon.),

"Meriden," Exmouth, S. Devon.

Science Master, Aldenham School, Nr. Elstree, Herts. Late Scholar Trin. Coll., Oxon. First Class Honours Final Honours School, Natural Science, Oxford. Joint Author "The Constitution of Hydrocyanic, Cyanic, and Cyanuric Acids," *Journal Chem. Soc.*, March, 1902. "Nitrogen Chlorides and Bromides derived from *o*-Substituted Anilides," *Journal*, July 1902. "The Cloëz Reaction," *Proceedings*, March 1902.

F. D. Chattaway. D. H. Nagel.
K. J. P. Orton. R. T. Lattey.
W. H. Hurtley. Allan F. Walden.

Walsh, Thomas Crosbie,

"Sunnyside," Muswell Avenue, Muswell Hill, N.

Chemist. Certificated Student in Chemistry, City and Guilds Technical College, Finsbury (Professor R. Meldola, F.R.S.). Late Chemist to Dental Manufacturing Company, Lexington Street, W. Chemist to Borax Consolidated, Ltd., Antofagasta, Chile, S. America.

R. Meldola. F. Southerden.
W. A. Handcock. J. V. Eyre.
W. H. Barlow.

Williams, David John,

1, St. Agnes Place, Kennington Park, London, S.E.

Lecturer, Demonstrator in Chemistry and Histology at the Metropolitan College Pharmacy. Sessional Silver Medallist at the Metropolitan College Pharmacy. Major Qualification, Pharmaceutical Society. Advanced Certificates Mathematics, Chemistry (Inorganic), and Mechanics.

W. Watson Will.	F. B. Power.
Thos. Tyrer.	*Peter MacEwan.*
Edward Divers.	*W. L. Howie.*

Wilmore, Albert,

158, Skipton Road, Colne.

Principal, Municipal Technical School, Colne. Twelve years a Teacher of Chemistry, Inorganic and Organic. For three years Chemist to large Tanning, Fellmongering, Degreasing, and Leather Dyeing Works of Messrs. W. and J. Sagar, Colne, Lancs., and Hackbridge, London. Contributed several Chemical Processes to the industry, which are now working successfully. At present Consulting Chemist to same firm, and to other firms in district (as occasional chemist).

William A. Tilden.	James C. Philip.
W. Palmer Wynne.	W. B. Hards.
Chapman Jones.	*Henry R. Procter.*

Yeomans, William Wade,

Middlewich, Cheshire.

Research Chemist and Analyst. Works Chemist. Was engaged as apprentice in the Works of Messrs. Murgatroyd and Co., Middlewich; then two Sessions in the Chemical Department, Technical School; afterwards 5½ years with Messrs. Levinstein and Co., Blackley.

James Grant.	F. S. Sinnatt.
Herbert N. Morris.	L. G. Radcliffe.

Jul. Hübner.

Young, Andrew,

1, Avenue Terrace, Cape Town.

Professor of Geology and Mineralogy in South African College, Cape Town. M.A. and B.Sc., Edin. University. Formerly Demonstrator in Chemical Department, Heriot Watt College, Edinburgh. Now Professor of Geology and Mineralogy in South African College.

Alex. Crum Brown.	Hugh Marshall.
J. Gibson.	D. Brown.
Leonard Dobbin.	John S. Ford.

The following were authorised by the Council under Bye-law I. (3):

Bhaduri, K.,
Canning College, Lucknow.

M.A. in Chemistry. 1st in First Division and Gold Medallist, 1889, Calcutta University. Worked as Personal Assistant to Professor Pedlar, F.R.S., Presidency College, Calcutta, in carrying out some of his researches. Some time Professor of Applied Chemistry, Technical Institute, Baroda. Late Professor of Physics and Chemistry, Bishop's College, Calcutta. Professor of Chemistry, Canning College. Now making researches on some raw products of India.

A. Sanyal.	*Alex. Pedler.*
E. G. Hill.	*Arthur Richardson.*

Prichard, George Montague,
Ramtek, Nagpur, C.P., India.

Analyst to Central Provinces of India Prospecting Scte. Three years' service with Edwd. Riley, F.I.C., F.C.S. Obtained every Chemistry Prize at Felsted School for which I was entitled to enter, under A. E. Munby, F.C.S. Obtained highest marks in the School in Oxford Junior Local in Chemistry at 13 years of age. Two years service as Chemist to 14 Manganese Properties in India.

Edwd. Riley.	Alan E. Munby.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 11/2/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 260.

Thursday, February 5th, 1903. Dr. E. Divers, F.R.S., Vice-President, in the Chair.

Mr. W. Carter White was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Arthur William Eastwood, B.A., Newton College, S. Devon.
John Percy Edgerton, 39, White Hart Lane, Barnes, S.W.
George Howsam, School of Science, Peterborough.
Alfred Owen Jones, 18, Queen's Gardens, Tetherdown, Muswell Hill.
James Stewart Kerr, The Grove, Ladywood Road, Birmingham.
George Siddle, Middleton-One-Row, R.S.O.
William Francis John Wood, B.Sc., Doncaster Road, Barnsley.
Edward Chancey Worden, Millburn, New Jersey, U.S.A.

Of the following papers, those marked * were read :

*18. "The solubilities and transition points of lithium nitrate and its hydrates." By F. G. Donnan and B. C. Burt.

Lithium nitrate was found to yield two hydrates, $LiNO_3,3H_2O$ and $LiNO_3,\frac{1}{2}H_2O$. Of these, the former has been obtained previously by

Dott, who showed it to be the trihydrate and not $LiNO_3,2\frac{1}{2}H_2O$ as stated by Kremers and by Troost. Determinations of the solubility of these hydrates and also of the anhydrous salt were carried out, and in this way the various quadruple points of the system located, the position of these points being also confirmed by thermometric and dilatometric measurements. The trihydrate is of special interest as it possesses a stable melting point. The equilibrium curve in the neighbourhood of this point was fully investigated.

The following is a list of the melting points and quadruple points of the system:

Cryohydrate point of $LiNO_3,3H_2O$, −17·8°.

Melting point of $LiNO_3,3H_2O$, 29·88°.

Transition point, trihydrate + semihydrate $\rightleftarrows$ saturated solution, 29·6°.

Transition point, semihydrate $\rightleftarrows$ anhydrous salt + saturated solution, 61·1°.

*19. "The synthesis of αα-diglutaric acid." By O. Silberrad and T. H. Easterfield.

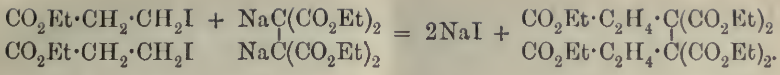
The action of iodine on the sodium derivative of ethyl α carboxyglutarate does not lead to the formation of the hexa-ethyl ester, $CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}C(CO_2Et)_2{\cdot}C(CO_2Et)_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et$, from which αα-diglutaric acid could be obtained by successive hydrolysis and loss of carbon dioxide, but gives rise to the hitherto unknown *ethyl α-iodo-α-carboxyglutarate* (*ethyl α-iodobutane-ααγ-tricarboxylate*), the reaction taking place in accordance with the following equation:

$$CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CNa(CO_2Et)_2 + I_2 = CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CI(CO_2Et)_2 + NaI.$$

Bromine behaves similarly, yielding *ethyl α-bromo-α-carboxyglutarate* (*ethyl α-bromobutane-ααγ-tricarboxylate*) (sp. gr. 1·325 at 15°/4°).

Again, on heating the sodium derivative with these halogenated esters, no condensation occurred, but instead a mixture of alkyl carboxyglutarate and a new ethyl carboxyglutaconate (b. p. 173—176° under 15 mm. pressure) was produced, the latter differing from its isomeride (ethyl *iso*aconitate) in that it does not contain a mobile hydrogen atom and can therefore neither assume the enolic form nor yield a sodium derivative.

As the preceding method failed to give rise to the desired ester, its synthesis was next tried by one of the authors (O. S.) in the manner represented by the following equation:



$$\begin{array}{l}CO_2Et\cdot CH_2\cdot CH_2I\\ CO_2Et\cdot CH_2\cdot CH_2I\end{array} + \begin{array}{l}NaC(CO_2Et)_2\\ NaC(CO_2Et)_2\end{array} = 2NaI + \begin{array}{l}CO_2Et\cdot C_2H_4\cdot C(CO_2Et)_2\\ CO_2Et\cdot C_2H_4\cdot C(CO_2Et)_2.\end{array}$$

This process proved successful and yielded ethyl αα-di-α-carboxyglutarate (isolated as αα-diglutaric acid) together with ethyl $\Delta^{\alpha\beta}$-α-dihydromuconate (?), ethyl butane-αγγδδ-pentacarboxylate (b. p. 215—218° under 17 mm. pressure), which, on saponification, yielded butane-αγδ-tricarboxylic acid (m. p. 122°), and ethyl ethylenetetracarboxylate.

A fractionator was described for distilling under greatly diminished pressure; this apparatus was designed in order to overcome the difficulty due to the variation of pressure caused by throttling, which is experienced under these conditions when the ordinary columns are employed.

*20. “Distillation of chlorine water.” By A. Richardson.

Pickering (*Trans.*, 1870, 37, 139) has shown that, when aqueous solutions of chlorine are heated in an open vessel, a residue containing hydrochloric acid remains behind after all the active chlorine has been expelled, and the present work was undertaken in order to find out whether the escaping chlorine was present wholly in a free state or mixed with one of its oxy-acids.

When chlorine water was heated in a retort, the distillate, which was obtained below 100°, contained free chlorine, the gas being readily displaced by a current of air; the solution in the retort, however, still contained active chlorine, for it liberated iodine from potassium iodide, bleached indigo solution immediately, and gave, on shaking with mercury, a brownish-yellow deposit resembling that obtained with hypochlorous acid. This result proved to be independent of the action of light, and was not influenced by further purification of the chlorine.

Quantitative estimations of the chlorine in the aspirated distillate gave, for the active chlorine estimated iodometrically, values double those obtained for the total chlorine found with silver nitrate after treatment with sulphur dioxide. These results show that the active chlorine is present as hypochlorous acid.

Distillation of chlorine water in a current of chlorine gas showed that the hydrochloric acid formed in the residual solution was equivalent to the hypochlorous acid found in the distillate, indicating that a portion of the chlorine reacts with the water according to the equation $Cl_2 + H_2O = HCl + HClO$.

Again, when aliquot parts of the distillate and residue obtained on distilling chlorine water were mixed, a solution having all the properties of the original chlorine water was reproduced. It would appear, therefore, that hydrochloric and hypochlorous acids are separated during distillation as the products of the partial change of chlorine water.

When chlorine water was heated in a flask provided with a reflux condenser, so that the distillate returned to the original solution, the ratio of active to total chlorine found was that required for a solution of free chlorine, showing that the solution is stable when the separation of the two acids is prevented.

A further study of the change showed that the amount of hypochlorous acid passing over decreased with the increase in strength of the hydrochloric acid formed in the solution. With very dilute solutions of chlorine water, the whole of the free halogen employed entered into reaction with the solvent, the oxy-acid only having been found in the distillate.

Finally, distillation of very dilute chlorine water in a vacuum at the ordinary temperature gave a distillate containing the oxy-acid, showing that the reaction occurs at the ordinary temperature as well as at the boiling point.

21. "A new vapour density apparatus." By John S. Lumsden.

This apparatus is based on the principle that the molecular weights of all substances in the state of gas, when occupying the same volume and at the same temperature, exert the same pressure. The pressure produced at a given temperature by the molecular weight in milligrams is either found experimentally by vaporising a substance of known molecular weight or calculated from the dimensions of the apparatus; then, from the pressure produced by vaporising a weighed quantity of the substance the molecular weight of which is required, the weight in milligrams which would produce the milligram molecular pressure is found. This is taken as the molecular weight.

No barometric reading is necessary, and when the constant of the apparatus has been found and the substance weighed, the experiment is completed in two minutes, and the calculation of the result may be made in another two minutes.

By slightly modifying the arrangement of the apparatus, the substance may be vaporised under diminished pressure or in an inert gas, and the experiment may be performed at any temperature. The instrument, which is quite as accurate as the Victor Meyer apparatus, is, owing to its simplicity, well adapted for general laboratory work.

22. "A new form of pyrometer." By John S. Lumsden.

A constant volume instrument was described in which a weighed quantity of a substance is vaporised and the pressure measured by a mercury gauge.

The pressures produced by equal weights of substance are proportional to the absolute temperatures; therefore, if at two temperatures the pressures produced by equal weights are measured and one temperature is known, the other can be calculated.

The instrument may be made of glass, porcelain or metal, and high temperatures may be measured within a few degrees.

23. "Tertiary butylphenol." By E. W. Lewis.

The author draws attention to the non-formation of phenyl-*ter.*-butyl ether on digesting phenol in alcoholic solution with *ter.*-butylchloride and excess of alkali, and to the production in these circumstances of the isomeric *ter.*-butylphenol. Other instances of the difficulty attending the preparation of phenol ethers containing a tertiary radicle in place of the hydrogen of the phenolic hydroxyl group are cited in the paper.

ADDITIONS TO THE LIBRARY.

I. Donations.

Danger, Ferdinand Philippe. The art of glass-blowing, or plain instructions for making the chemical and philosophical instruments which are formed of glass. ill. London 1831.

Baumé, Antoine. Mémoire sur la meilleure manière de construire les alambics et fourneaux propres à la distillation des vins pour en tirer les eaux-de-vie. ill. Paris 1778.

Klaproth, Martin Henry. Analytical essays towards promoting the chemical knowledge of mineral substances. Translated from the German. London 1801.

Rideal, Samuel. Glue and glue testing. London 1900.

From the Author.

Bigelow, W. D. Foods and food control. Parts I—V. (*being* U.S. Dept. of Agriculture, Bureau of Chemistry, Bulletin No. 69.). Washington 1902.

II. By Purchase.

Boyle, Robert. De ipsa natura, sive libera in receptam naturæ notionem disquisitio ad amicum. London 1687.

Rây, Praphulla Chandra. A history of Hindu chemistry from the earliest times to the middle of the sixteenth century A.D. with Sanskrit texts, variants, translation, and illustrations. Vol. I. London 1902.

Lévy, Lucien. Les mouts et les vins en distillerie. Paris 1903.

Whetham, William Cecil Dampier. A treatise on the theory of solution, including the phenomena of electrolysis. Cambridge 1902.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on **Wednesday, March 25th, 1903**, this being the day fixed for the Annual General Meeting. Further particulars will be announced shortly.

At the next meeting, on **Wednesday**, February 18th, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The molecular rearrangement of *N*-substituted imino-ethers." By G. D. Lander.

"The nature and probable mechanism of metal replacement in tautomeric compounds." By G. D. Lander.

"The chlorine derivatives of pyridine. Part VIII. The interaction of 2:3:4:5-tetrachloropyridine with ethyl sodiomalonate." By W. J. Sell and F. W. Dootson.

"The biological method for resolving inactive acids into their optically active components." By A. McKenzie and A. Harden.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 28/2/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 261.

Wednesday, February 18th, 1903. Professor J. EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

Mr. J. P. Millington was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.

Robert Gordon Bibby, New College, Oxford.
Thomas Divine, M.B., C.M., 11, Spencer Place, Leeds.
Archibald Louis Robinson, B.A., 40, Trinity College, Dublin.
Montague White Stevens, 2, Richmond Place, London, S.W.

It was announced that the following changes in the Officers and Council were proposed by the Council:

As President: Prof. Tilden, F.R.S., *vice* Prof. J. Emerson Reynolds, F.R.S.
As Treasurer: Dr. Horace T. Brown, F.R.S., *vice* Prof. Tilden, F.R.S.
As Secretary: Prof. Wynne, F.R.S., *vice* Prof. Dunstan F.R.S.
As Vice-Presidents: Prof. Dunstan, F.R.S., and Mr. David Howard, *vice* Prof. Divers, F.R.S., and Dr. Stevenson.
As Ordinary Members of Council: Dr. J. T. Hewitt, Dr. C. A. Kohn, Dr. E. J. Mills, F.R.S., and Dr. S. Ruhemann, *vice* Mr. H. B. Baker, F.R.S., Dr. Chattaway, Prof. Clowes, and Dr. Lewkowitsch.

Dr. Hewitt, Dr. Thorne, and Dr. Orton were appointed to audit the Society's accounts.

INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

By direction of the Council, the following letter was read announcing the formation of a Joint Organising Committee in this country in connection with the International Congress of Applied Chemistry which is to be held in Berlin next June.

Society of Chemical Industry,
Palace Chambers,
9, Bridge St., Westminster, London, S.W.

February 10*th*, 1903.

"*International Congress of Applied Chemistry, Berlin.*"

Dear Sir,

I am directed to inform you that at the conference held at this office on the 6th inst. and referred to in my letter of the 26th ult., the following resolutions were passed:

1. That the delegates appointed by the Royal Society, Chemical Society, and Society of Chemical Industry, to represent these Societies at the International Congress of Applied Chemistry to be held in Berlin in June next, agree to form the joint Organising Committee contemplated in the letter of May 30th last from the President of the Organising Committee at Berlin.

2. That the Organising Committee so formed invites the co-operation of the other Learned and Industrial Societies in Great Britain, whose members are interested in Applied Chemistry.

3. That the President of the Society of Chemical Industry be requested to act as Chairman of this Organising Committee.

4. That Mr. C. G. Cresswell be requested to act as Secretary *pro tem.*

5. That a copy of these resolutions be communicated to Dr. Otto Witt, President of the Congress.

I remain,
Your obedient servant,
(signed) CHAS. G. CRESSWELL.

The Secretary,
Chemical Society.

The following delegates have been appointed by the Council to represent the Chemical Society at the Congress, Prof. Tilden, Prof. Dunstan, Prof. W. H. Perkin, jun., and Dr. A. Scott.

Fellows of the Society who propose to attend the Congress next June are requested to send their names to the Secretaries so that they may be communicated to the Organising Committee in Berlin.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Gilbert John Alderton.
George Henry Appleyard.
Edwin Bayles Atkinson.
K. Bhaduri, M.A.
William Bowen.
Samuel Bradbury.
George Thomas Branch.
Hubert William Bywaters, Ph.D.
William Henry Cadman.
John Castell-Evans.
Arthur John Codling.
Francis George Cousins.
Benjamin Claxton Coyle.
Cecil Henry Desch, Ph.D., D.Sc.
Archibald Sefton Elford, B.A.
Robert Crosbie Farmer, M.Sc., Ph.D.
Leonard King Hindmarsh, B.A.
Franklin Wise Howorth.
Moung Tha Huyin, B.A.
Maurice Kemp-Welch, B.A.
Frederic Herbert Lees.
Arthur Graham Leigh.
Harry Percy Lewis.
Percy George Mander, B.Sc.
Frederick O'Brien, M.Sc.
George Montague Prichard.
Thomas Samuel, B.A.
Alfred H. Scholefield, B.A., B.Sc.
Samuel Edward Sibley.
Alec Bowring Steven, B.Sc.
George Malcolm Thomson.
Charles Tilburn.
Stanley Tolson.
Francis Digby Toyne.
Duncan Turner.
John Mello Wadmore, B.A.
Thomas Crosbie Walsh.
David John Williams.
Albert Wilmore.
William Wade Yeomans.
Andrew Young, M.A., B.Sc.

Of the following papers, those marked * were read:

*24. "The molecular rearrangement of *N*-substituted imino ethers."

By G. D. Lander.

The rearrangement of the atomic grouping ·C(OR):N· into ·CO·NR· may be effected catalytically (Knorr and Wheeler) or by heating (Wislicenus), and both kinds of isomerisation have been studied with some of the recently prepared *N*-substituted imino-ethers.

Alkyl iodides prove more useful in the catalytic rearrangement than bromides or chlorides, and the isomerisation by means of iodides has been examined with the following imino-ethers: *N*-phenylacetimino-methyl and -ethyl, *N*-*o*-tolyl- and *N*-*p*-tolylacetimino-ethyl, *N*-phenylbenzimino-methyl and -ethyl; *N*-*o*-tolyl- and *N*-*p*-tolylbenzimino-methyl and -ethyl, *N*-methylbenzimino-methyl and -ethyl, *N*-ethylbenziminomethyl and -ethyl, and *N*-benzylbenzimino-methyl and -ethyl.

Isomerisation occurs more readily with the methyl than with the ethyl compounds, the former, for the most part, undergoing rearrangement at 100°, a temperature at which there is very little change with the latter. The ease of transformation also depends on the orientation of the aryl group attached to nitrogen, *p*-tolyl changing more easily than *o*-tolyl compounds.

The following substituted amides which result from the isomeric change do not appear to have been previously described. *Benzmethyl*-o-*tolylamide* (m. p. 65—66°) crystallises in prisms from ether and light petroleum. *Benzethyl*-o-*tolylamide* melts at 71—72°. *Benzmethyl*-p-*tolylamide* and *benzethyl*-p-*tolylamide* form prisms melting at 46—48° and 38—40° respectively. *Benzmethylbenzylamide* and *benzethylbenzylamide* are liquids boiling respectively at 213—214° (11 mm.) and 214—216° (12 mm.).

The rearrangement by heat occurs far less readily. *N*-Phenylacetimino-methyl ether undergoes partial isomerisation on prolonged boiling, and considerable isomeric change of *N*-methylbenzimino-methyl ether was obtained after 9 hours heating at 250—270°. With *N*-phenylbenzimino-methyl ether (*Ber.*, 1900, **33**, 1470), less conclusive results were got. With ethyl-imino-ethers, the main change produced by prolonged heating is the elimination of ethylene and regeneration of the parent amide. It is therefore doubtful whether the isomerisation can be caused by simple heating.

Attention was drawn to the formation of ethyl paracyanoformate, $(CN\cdot CO_2Et)_x$, from diethyl imino-oxalate, $HN{:}C(OEt)CO_2Et$, by loss of alcohol and subsequent polymerisation.

DISCUSSION.

Dr. ORTON asked whether Dr. Lander had brought about the isomeric change of an *O*-iminoether into the *N*-alkyl compound by use of an alkyl iodide, in which the alkyl group was not identical with the alkyl group of the iminoether. If the first stage of the change is the formation of an additive product of the alkyl iodide and the iminoether, then, if sufficient quantity of the alkyl iodide be used, a *N*-alkyl derivative should be obtained, which would possess the alkyl group of the alkyl iodide, and not that originally present in the *O*-iminoether.

Dr. LANDER in reply stated that he had performed an experiment in which the catalytic action of normal propyl iodide (1 mol.) on a methyliminoether had been found to yield chiefly substituted methylamide, the corresponding propyl compound being also produced, but to a less extent, the trace of methyl iodide first formed proving more effective than the relatively large amount of higher iodide also present.

*25. "The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds." By G. D. Lander.

The results of the alkylation of keto-enolic compounds and substituted amides by means of dry silver oxide and alkyl iodides (*Trans.*, 1900, **77**, 729; 1901, **79**, 690; 1902, **81**, 591; *Proc.*, 1901, **17**, 59) were discussed in the light of the addition hypothesis and its modifications, and also with reference to the views on the mechanism of the replacement of metallic radicles in tautomeric compounds as developed by Wislicenus (Tautomerie, *Ahrens-Sammlung*, 1897, 249). The opinion was advanced that none of these hypotheses is competent to give a perfectly general elucidation of the phenomena, and an explanation was therefore sought in the hypothesis of the display of tautomeric relationships by the compounds containing metallic radicles.

In order to test the validity of silver oxide alkylation as a basis for the discussion of the mechanism of this replacement of metallic radicles, the alkylation of ethyl oxaloacetate and formophenylamide by this method was investigated; the former yields ethyl ethoxyfumarate on treatment with silver oxide and ethyl iodide, a result agreeing with that obtained by Nef (*Annalen*, 1893, **277**, 73); the latter, on methylation with silver oxide, gives chiefly *N*-phenylforminomethyl ether, $NPh{:}CH{\cdot}OMe$, together with small amounts of formophenylmethylamide, $CHO{\cdot}NMePh$, and diphenylformamidine. The production of the last two substances does not appear to have been noted in the methylation of silver formophenylamide by Comstock and Kleeberg (*Amer. Chem. J.*, 1891, **13**, 514), but a control experiment showed that both are formed in their process to a somewhat greater extent than by the silver oxide methylation.

Methylation of the substituted amides by means of silver oxide leads to the formation of mixtures of imino-ethers and isomeric substituted amides, ethylation of these amides under similar conditions apparently gives rise exclusively to imino-ethers. When, however, the ethylation of acetophenylamide by means of silver oxide is conducted in a closed vessel at 100°, *N*-phenylacetiminoethyl ether, $NPh{:}CMe{\cdot}OEt$, and the isomeric amide, $NEtPh{\cdot}CMeO$, are both produced just as isomerides are formed in the methylation of the same amide in open vessels at the ordinary temperature or at 40—50°.

N-Phenylbenziminomethyl ether, $NPh{:}CPh{\cdot}OMe$, does not undergo isomeric change when boiled in benzene solution for 4 hours with dry silver oxide and methyl iodide.

*26. "The chlorine derivatives of pyridine. Part VIII. The interaction of 2:3:4:5-tetrachloropyridine with ethyl sodiomalonate." By W. J. Sell and F. W. Dootson.

The chief product of the interaction of 2 : 3 : 4 : 5-tetrachloropyridine and ethyl sodiomalonate is ethyl 2 : 3 : 5-trichloropyridyl-4-malonate which, on hydrolysis, loses carbon dioxide yielding 2 : 3 : 5-trichloropyridyl-4-acetic acid. The latter compound is non-volatile, and when heated a little beyond its melting point, is quantitatively decomposed into 2 : 3 : 5-trichloro-4-methylpyridine and carbon dioxide. On oxidation with potassium permanganate, 2 : 3 : 5-trichloro-4-methylpyridine yields the corresponding acid. These changes may be thus represented:

$$C_5NHCl_3{\cdot}CH(CO_2Et)_2 \rightarrow C_5NHCl_3{\cdot}CH_2{\cdot}CO_2Et \rightarrow C_5NHCl_3{\cdot}Me \rightarrow C_5NHCl_3{\cdot}CO_2H.$$

*27. "The biological method for resolving inactive acids into their optically active components." By A. McKenzie and A. Harden.

In much of the research in this field, no attempt has been made to work with pure cultures. Hence, although the optically active products desired in certain cases were successfully obtained, there is often doubt as to the exact organism by which the resolution had actually been effected, the object having been to obtain the pure active isomeride rather than to examine the action of any particular organism on the inactive acid, and therefore many resolutions ascribed to *Penicillium glaucum* have probably been accomplished, not by that mould, but by bacteria with which the solution under investigation had accidentally become contaminated (compare Landolt, *Das optische Drehungsvermögen*, 1898, 63).

The authors have investigated the action of *Penicillium glaucum*, Link; *Sterigmatocystis nigra*, van Tieghem (= *Aspergillus niger*, van Tieghem, *olim*); and *Aspergillus griseus*, Link, and their action on racemic, dimethoxysuccinic, lactic, α-ethoxypropionic, α-propoxypropionic, α-hydroxybutyric, β-hydroxybutyric, glyceric, malic, methoxysuccinic, ethoxysuccinic, propoxysuccinic, mandelic, methoxyphenylacetic, ethoxyphenylacetic, propoxyphenylacetic, α-bromopropionic, α-bromobutyric, chlorophenylacetic, and monobromosuccinic acids and alanine were investigated.

Their experiments tend to show that the mode of action of the moulds is such that the one active isomeride is attacked more readily than the other, and that the extent of the resolution depends solely on the difference of this rate of attack. The view generally held, namely, that the one isomeride is attacked whilst the other remains untouched, does not appear to be correct. Two other points were kept in view, firstly, whether, from the action of organisms, any definite relationship could be established as to the configuration of the various related acids, and, secondly, whether the active products of the action of different organisms on the same series of acids show any regularity as to sign of rotation.

28. "Colour changes observed in solutions of cobalt chloride." By W. N. Hartley.

A paper by Donnan and Bassett (*Trans.*, 1902, **81**, 939) contains a reference to some work on the action of heat on the absorption spectra and chemical constitution of saline solutions, and to this (*Sci. Trans. Roy. Dubl. Soc.*, 1900, [vii], 253) the author takes exception as being misleading in certain important particulars.

The characteristic spectra of aqueous solutions of cobalt chloride saturated at 20°, as seen in wedge-shaped cells at temperatures between 23° and 93°, differ from those of the hydrochloric acid solution; the compound formed at 93—100° in neutral solutions seems to be the dihydrate, $CoCl_2,2H_2O$, and not the anhydrous salt.

The solution in hydrochloric acid probably contains a compound of the salt with the acid, for the spectrum is peculiar, and, moreover, the anhydrous salt, which is insoluble in dry ether, dissolves in this medium when the mixture is treated with carefully dried hydrogen chloride.

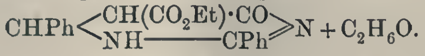
Pure cobalt sulphate may be heated to 300° without perceptible change, and does not alter at a temperature approaching 800°.

Zinc chloride added to a solution of cobalt chloride prevents the development of the blue coloration on warming; this action may be explained by assuming the formation of a double chloride which does not give rise to the dihydrate. The changes produced by mercuric chloride on an alcoholic solution of cobalt chloride are due to the formation of the double cobalt mercuric chloride (Claudet's salt), a substance which in the solid state is particularly sensitive to changes of temperature. If the blue solution observed by Donnan and Bassett during the electrolysis of cobalt chloride is due to the formation at the anode of a complex ion, it should be possible to separate and analyse solutions containing these ions and so determine the ratio of cobalt to chlorine.

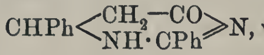
The hypothesis that hydrated salts can exist in highly concentrated solutions and can undergo dissociation on raising the temperature accounts precisely for the phenomena observed not only in the case of cobalt chloride but also in that of its iodide, bromide, and the salts of other metals.

29. "The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids." By S. Ruhemann.

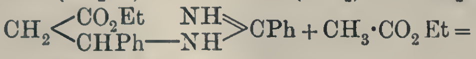
Ethyl benzylidenemalonate condenses with benzamidine to form *ethyl dihydrodiphenylpyrimidonecarboxylate* (m. p. 188°) according to the equation: $\mathrm{CHPh{:}C(CO_2Et)_2 + CPh(NH_2){:}NH} =$



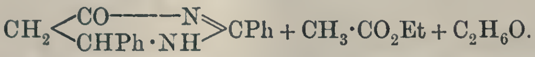
$$\mathrm{CHPh}{<}\begin{array}{l}\mathrm{CH(CO_2Et)\cdot CO}\\ \mathrm{NH{-\!\!-\!\!-}CPh}\end{array}{>}\mathrm{N} + \mathrm{C_2H_6O}.$$

When this compound is treated with ammonia, the ring opens and then closes, with the loss of carbon dioxide and alcohol, forming *dihydrodiphenylpyrimidone* (m. p. 180°),  $\mathrm{CHPh}{<}\begin{array}{l}\mathrm{CH_2{-}CO}\\ \mathrm{NH\cdot CPh}\end{array}{>}\mathrm{N}$, which is also formed by the action of benzamidine on ethyl benzylideneacetoacetate in accordance with the following equation:

$$\mathrm{CH_3\cdot CO\cdot C(CO_2Et){:}CHPh + CPh(NH_2){:}NH + C_2H_6O} =$$



$$\mathrm{CH_2}{<}\begin{array}{l}\mathrm{CO_2Et\quad NH}\\ \mathrm{CHPh{-\!\!-}NH}\end{array}{>}\mathrm{CPh + CH_3\cdot CO_2Et} =$$



$$\mathrm{CH_2}{<}\begin{array}{l}\mathrm{CO{-\!\!-\!\!-}N}\\ \mathrm{CHPh\cdot NH}\end{array}{>}\mathrm{CPh + CH_3\cdot CO_2Et + C_2H_6O}.$$

In studying the action of ammonia on ethyl esters of olefine-β-ketocarboxylic acids, it was found that both ethyl ethylideneacetoacetate and ethyl furylideneacetoacetate are transformed by ammonia into ethyl hydrocollidinedicarboxylate and ethyl hydrofuryllutidinedicarboxylate respectively. The formation of these compounds depends on the previous decomposition of the ethyl olefine-β-ketocarboxylic ester into ethyl acetoacetate and the aldehyde ammonias, which, in turn, condense to form the hydrogenised pyridine derivatives.

Ethyl benzylideneacetoacetate, $\mathrm{CH_3\cdot CO\cdot C(CO_2Et){:}CHPh}$, behaves differently towards ammonia and yields *benzylideneaminoacetone*, $\mathrm{CH_3\cdot CO\cdot C(NH_2){:}CH\cdot C_6H_5}$ (colourless needles, m. p. 125°). This substance, on heating with acids, readily loses benzaldehyde. On carefully warming the ketone with concentrated hydrochloric acid, an insoluble chloride is produced which may be regarded as diacetobenzylideneimide hydrochloride, $\mathrm{NH(CAc{:}CHPh)_2,HCl}$.

30. "Derivatives of *p*-aminoacetophenone." By F. D. Chattaway.

In the course of a study of the transformation of diacetanilide into aceto-*p*-aminoacetophenone under the influence of hydrogen chloride or of zinc chloride, the following compounds have been prepared. They are formed by the ordinary processes, but in the preparation of the nitrogen-halogen derivatives great care must be taken to avoid the liberation of free halogen, otherwise substitution in the ketonic chain occurs.

p-*Acetylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}NAcCl$, colourless, pearly plates, readily soluble in chloroform, m. p. 72°; p-*acetylbromoaminoacetophenone*, $C_6H_4Ac{\cdot}NAcBr$, yellow, rhombic plates, m. p. 83°; p-*propionylaminoacetophenone*, $C_6H_4Ac{\cdot}NH{\cdot}COEt$, colourless prisms, m. p. 136°; p-*propionylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}N(COEt)Cl$, colourless plates, m. p. 42°; p-*benzoylaminoacetophenone*, $C_6H_4Ac{\cdot}NH{\cdot}COPh$, thin, colourless plates, m. p. 205°; p-*benzoylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}N(COPh)Cl$, colourless plates, m. p. 77°.

On heating, the nitrogen-halogen derivatives undergo transformation with considerable decomposition; when dissolved and warmed in acetic acid, halogen passes from the nitrogen into the ortho-position in the nucleus, whilst, if free halogen is liberated, substitution in the methyl group of the ketone also takes place.

ADDITIONS TO THE LIBRARY.

II *By Purchase.*

Herzberg, Wilhelm. Papierprüfung. Eine Anleitung zum Untersuchen von Papier. 2nd ed. ill. Berlin 1902.

Koenigsberger, Leo. Hermann von Helmholtz. Vol. I. With 3 portraits. Braunschweig 1902.

Vaubel, Wilhelm. Lehrbuch der theoretischen Chemie. Vol. I. Materie und Energie—Molekül und Lösung. Vol. II. Zustandsänderungen und chemische Umsetzungen. ill. Berlin 1903.

Borchers, William. Elektro-Metallurgie. Die Gewinnung der Metalle unter Vermittlung des elektrischen Stromes. 3rd ed. Part I. ill. Leipzig 1902.

Höber, Rudolf. Physikalische Chemie der Zelle und der Gewebe. ill. Leipzig 1902.

Hofmann, Karl. Die radioactiven Stoffe nach dem gegenwärtigen Stande der wissenschaftlichen Erkenntnis. Leipzig 1903.

Zellner, Julius. Die künstlichen Kohlen für elektrotechnische und elektrochemische Zwecke, ihre Herstellung und Prüfung. ill. Berlin 1903.

Naske, Carl. Die Portland-Cement-Fabrikation. Ein Handbuch für Ingenieure und Cementfabrikanten. ill. Leipzig 1903.

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 25th, 1903** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets must be received not later than **Wednesday, March 18th.**

Tickets will be forwarded to Fellows on receipt of a remittance for the number of tickets required, addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday,** March 25th, at **half past four** o'clock in the afternoon.

At the next meeting, on **Thursday,** March 5th, 1903, at **8** p.m., the following papers will be communicated:

"The mechanism of the reduction of potassium dichromate by sulphurous acid." By H. Bassett.

"The constitution of pilocarpine. Part IV." By H. A. D. Jowett.

"Preparation and properties of 1 : 4-(or 1 : 5)-dimethylglyoxaline, and 1 : 3-dimethylpyrazole." By H. A. D. Jowett and C. E. Potter.

"Some analyses of "Reh," or the alkaline salts in Indian usar land." By E. G. Hill.

"Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid." By W. H. Perkin, jun., and J. F. Thorpe.

"Camphor-β-thiol." By T. M. Lowry and G. C. Donington.

"Isomeric change of dibenzanilide into benzoyl-*o*-amino- and benzoyl-*p*-amino-benzophenones." By F. D. Chattaway.

"The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient." By J. C. Cain and F. Nicoll.

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Issued 14/3/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 262.

Thursday, March 5th, 1903. Dr. W. H. Perkin, F.R.S., Vice-President, in the Chair.

Messrs. Brincker, Howorth, Beanes, J. E. Mackenzie, Cousins, and Desch were formally admitted Fellows of the Society.

The lists of names of the Officers and Council proposed for Election by the Council were read from the Chair.

Certificates were read for the first time in favour of Messrs.

Henry Guest Adshead, Heysham, Wimbledon Park, Wimbledon.
Harford Montgomery Atkinson, 32, Bagnall Road, Milton.
George Neville Blackshaw, Agricultural College, Aspatria.
Harry T. Calvert, D.Sc., West Riding of Yorkshire Rivers Board.
Ben Caudwell, B.A., 28, Wigfull Road, Sheffield.
Alan Fletcher, 132, Holland Road, Kensington, W.
Arthur Ernest Pitt, 66, Abbot Road, Bromley, E.
Harold Russell Pitt, 8, Church Lane, Charlton, S.E.
Frederick Robertson, The Hewan, Bearsden, Glasgow.
Fitzroy Owen Jonathan Roose, Oxford Road, Bournemouth.
Henry Edward Stevenson, 5, Turner's Road, Bow, London, E.
James Bates Wilkinson, M.D., Town Hall, Oldham.

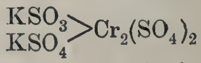
Of the following papers those marked * were read :—

*31. "The mechanism of the reduction of potassium bichromate by sulphurous acid." By H. Bassett, jun.

Berthier, who investigated the action of sulphur dioxide on solutions of potassium bichromate and potassium chromate (*Ann. Chim. Phys.*, 1843, [iii], 7, 77), stated that in both cases a mixture of sulphate and dithionate was formed, but without giving details.

The reaction has now been studied more fully, and the results show that 94—95 per cent. of sulphate and 5—6 per cent. of dithionate are formed, when potassium bichromate, potassium chromate, or chromic acid is reduced by sulphurous acid; the amount of dithionate produced being independent of the temperature.

Solutions containing known amounts of sulphurous acid and potassium bichromate were mixed, and the excess of sulphurous acid estimated with iodine and sodium thiosulphate, or the excess of chromate determined by means of ferrous ammonium sulphate.

The freshly reduced solutions do not give the reactions of either chromium or SO_4, and seem to contain a compound  $\begin{matrix}KSO_3\\KSO_4\end{matrix}>Cr_2(SO_4)_2$ (or the corresponding acid), which slowly decomposes into $Cr_2(SO_4)_3$ and K_2SO_3.

When sulphuric acid or potassium sulphate is added to these solutions, it enters into combination in such a way that the reactions of SO_4 are not given by the resulting mixture, and as many as 6 mols. of sulphuric acid may be taken up by 1 mol. of chromium sulphate.

Electrolytic experiments show that the green solutions contain a green anion which slowly decomposes into violet chromium and SO_4 ions.

*32. "The constitution of pilocarpine. Part IV." By H. A. D. Jowett.

The author showed that the constitutional formula for pilocarpine, suggested by Pinner and Schwarz, is only one of several equally probable on the results hitherto recorded.

The constitution of *iso*pilocarpine has, however, been determined by a study of the reactions of dimethylglyoxaline and dimethylpyrazole and by the formation of 1-methylglyoxaline, 1 : 4(or 1 : 5)-dimethylglyoxaline, 1 : 4(or 1 : 5)-methylamylglyoxaline, and probably 1 : 4

(or 1 : 5)-methylamyleneglyoxaline, together with ammonia and methylamine, when the alkaloid is distilled with soda-lime.

Dimethylglyoxaline, from *iso*pilocarpine, boiled at 210—215° and formed crystalline salts; *platinichloride*, m. p. 238—239°; *aurichloride*, m. p. 214—215°; *picrate*, m. p. 167°. It is isomeric and not identical with the dimethylglyoxalines described in the following note. On oxidation, it yields ammonia, methylamine, and acetic acid.

Methylamylglyoxaline, from *iso*pilocarpine, boiled at 158—160° under 10 mm. pressure; *platinichloride*, m. p. 198°; *picrate*, m. p. 134°; *aurichloride*, amorphous. On oxidation, this base yielded ammonia, methylamine, and *n*-hexoic acid.

Methylamyleneglyoxaline, which probably exists in the fraction boiling at 145—160° under 10 mm. pressure, was not isolated; its presence was inferred from the formation of butyric acid during oxidation.

*iso*Pilocarpinolactone, on oxidation with permanganate, yielded ammonia, methylamine, and pilopic acid, whilst pilocarpine gave rise to ammonia, methylamine, and homopilopic acid.

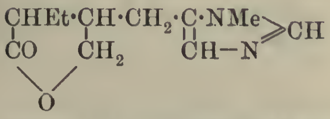
*iso*Pilocarpine, which could not be reduced electrolytically, did not form diacidic salts, and on titration behaved as a normal lactone.

*iso*Pilocarpine methiodide, with picric acid, yielded the compound previously described as methyl*iso*pilocarpine picrate, but which should be termed *iso*pilocarpine methyl picrate.

The absorption spectra of pilocarpine and *iso*pilocarpine, kindly determined by Prof. J. J. Dobbie, were absolutely identical.

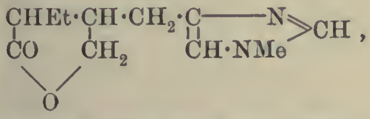
The following formulæ were proposed for pilocarpine and *iso*pilocarpine:

I.



or

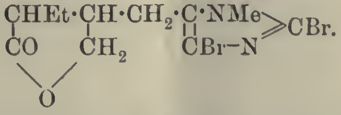
II.



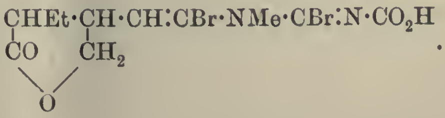
and it was suggested that pilocarpine and *iso*pilocarpine are stereoisomerides, the asymmetric carbon atom involved being that contiguous to the carboxyl residue.

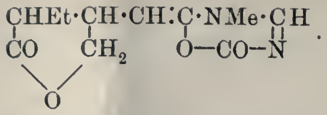
The following configurations were proposed on the basis of formula I:

Dibromopilocarpine or dibromo*iso*pilocarpine,

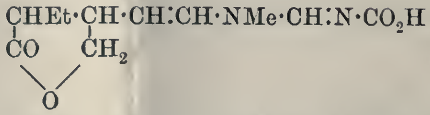


Dibromo*iso*pilocarpinic acid,



*iso*Pilocarpinolactone, 

$$\begin{array}{l} \mathrm{CHEt\cdot CH\cdot CH{:}C\cdot NMe\cdot CH} \\ \mathrm{CO\qquad CH_2\qquad O{-}CO{-}N} \\ \qquad \diagdown\;\diagup \\ \qquad\ \ \mathrm{O} \end{array}.$$

*iso*Pilocarpinic acid, 

$$\begin{array}{l} \mathrm{CHEt\cdot CH\cdot CH{:}CH\cdot NMe\cdot CH{:}N\cdot CO_2H} \\ \mathrm{CO\qquad CH_2} \\ \qquad \diagdown\;\diagup \\ \qquad\ \ \mathrm{O} \end{array}.$$

Bromocarpinic acid, $\mathrm{CO_2H\cdot CHEt\cdot CH_2\cdot CH{:}CH\cdot NMe\cdot CBr{:}N\cdot CO_2H}$.

It was shown that the explanation given by Pinner and Schwarz of the formation of pilocarpoic acid, $C_{11}H_{16}O_5N_2$, is quite untenable, but no suggestions as to the constitution of this substance or pilomalic acid were offered.

*33. "Preparation and properties of 1 : 4(or 1 : 5)-dimethylglyoxaline and 1 : 3-dimethylpyrazole." By H. A. D. Jowett and C. E. Potter.

These bases were prepared in order to compare their reactions with those of *iso*pilocarpine.

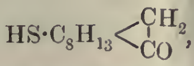
1 : 4(or 1 : 5)-*Dimethylglyoxaline*, obtained from 4(or 5)-methylglyoxaline (hitherto described as a liquid, but now obtained in crystals, m. p. 55°), is an oil boiling at 203° and forming an *aurichloride*, m. p. 215°; *platinichloride*, m. p. 239°; *picrate*, m. p. 167°; *methiodide*, m. p. 156°; and *hydrochloride*, m. p. 145°. Bromine gave a crystalline *dibromo*-derivative, m. p. 127°, but at 100° under pressure the reaction was complicated and a crystalline acid was produced. On oxidation, the base yielded ammonia, methylamine, and acetic acid, whilst by the action of potassium hydroxide the methiodide gave methylamine and acetic acid.

1 : 3-*Dimethylpyrazole*, prepared from 3-methylpyrazole, is a liquid boiling at 148°, which gives an *aurichloride*, m. p. 175°; *platinichloride*, m. p. 234°; *hydrochloride*, m. p. 160°; and *methiodide*, m. p. 256°. Bromine under ordinary conditions, or at 100° under pressure, gave a *dibromo*-derivative, m. p. 74°; 1-*methylpyrazole*-3-*carboxylic acid*, m. p. 222°, was obtained by oxidation of the base. The methiodide was scarcely attacked by potassium hydroxide.

Prof. C. R. Marshall states that these bases have no physiological action analogous to that of pilocarpine.

1 : 2-Dimethylglyoxaline forms a *picrate*, m. p. 179°; an *aurichloride*, m. p. 215°; a *platinichloride*, m. p. 230°; and a *methiodide* which does not melt below 300°.

*34. "Camphor-β-thiol." By T. M. Lowry and G. C. Donington.

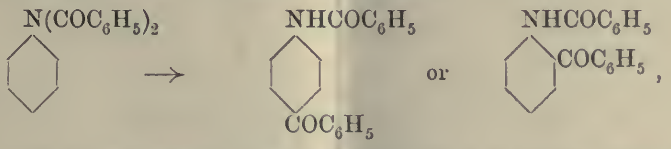
Camphor-β-thiol,  $HS\cdot C_8H_{13}<\begin{matrix}CH_2\\ |\\ CO\end{matrix}$, prepared by reducing the sulphochloride of Reychler's camphorsulphonic acid, is a colourless solid, of characteristic and not unpleasant odour, readily volatile with steam, which crystallises from alcohol in small, glistening prisms and melts at 66°; $[\alpha]_D = +6°$ (in acetone). It is insoluble in alkalis but forms a lead salt and a mercurichloride, $ClHg\cdot S\cdot C_{10}H_{15}O$. The disulphide melts at 224°; $[\alpha]_D = -90°$ (in acetone). The acetate, $AcS\cdot C_{10}H_{15}O$, forms needle-shaped crystals melting at 38°; $[\alpha]_D^{8°} = -41°$ (in acetone). The benzoate, $BzS\cdot C_{10}H_{15}O$, melts at 59°; $[\alpha]_D^{13°} = -16°$ (in acetone).

*35. "Isomeric change of dibenzanilide into benzoyl-*o*-amino- and benzoyl-*p*-amino-benzophenones." By F. D. Chattaway.

The author has previously shown (*Proc.*, 1902, **18**, 173) that acyl groups must be included among those which, under suitable circumstances, can pass from the nitrogen of an aromatic amine into the nucleus.

From the product of the isomeric change of diacetanilide at a high temperature, only that isomeride in which the acyl group has taken up the para-position can be isolated in quantity, although the ortho-compound is undoubtedly formed.

The transformation of dibenzanilide, however, is precisely analogous to others of the same type, and both the ortho- and the para-derivatives can be easily isolated. The isomeric change,



which takes place readily under the influence of hydrogen chloride, is best effected by heating aniline (1 mol.) with benzoyl chloride (2 mols.) for 18 to 20 hours at about 220°.

The product is hydrolysed by alcoholic hydrochloric acid, and the alcohol driven off in a current of steam. On adding water, the bases, which remain in solution as hydrochlorides, can be separated from tarry matters, and any unchanged aniline removed by making the solution alkaline with sodium hydroxide and distilling in steam. On cooling, the other bases solidify, and on dissolving the dry product in a little alcohol and adding a slight excess of strong sulphuric acid, the sparingly soluble sulphate of *p*-aminobenzophenone crystallises out. On making the mother liquor alkaline and distilling in superheated steam, *o*-aminobenzophenone slowly distils over and crystallises from the distillate in a pure state.

About 45 grams of *p*-aminobenzophenone and 15 grams of *o*-aminobenzophenone can be obtained from 100 grams of aniline.

*36. "Formation of purpurogallin by the electrolytic oxidation of pyrogallol." By A. G. Perkin and F. M. Perkin.

The methods hitherto employed for the production of purpurogallin give only a poor yield, but recent experiments made by the authors on the electrolytic oxidation of pyrogallol have shown that, in general, the quantity of purified product amounts to 37—45 per cent. of the calculated amount. The purified substance, which had all the properties of purpurogallin, and its acetyl derivative, gave, on analysis, figures which established its identity with this colouring matter.

The composition of the electrolytic bath has been frequently varied, and recently a solution containing 28 grams of pyrogallol, 10 c.c. *N*-sulphuric acid solution, and 50 grams of sodium sulphate in 500 c.c. of water has been found to be most effective. The best results have been obtained by using a rapidly rotating anode of platinum-iridium and a cathode of lead or graphite. The current density was 4—6 amperes with an *E.M.F.* of 8—10 volts. The behaviour of other phenolic substances under similar conditions is now under investigation. Gallic acid yields a small quantity of a product which probably contains the purpurogallincarboxylic acid recently described (*Trans.*, 1903, **83**, 199).

37. "The analysis of *Reh*, the alkaline salts in Indian *usar* land." By E. G. Hill.

The upland barren lands of India, extending over an area of about two million acres, which are mainly found between the Jumna and the Ganges, and also between the latter and the Gogra, contain so large a quantity of soluble salts in the soil that agriculture is practically impossible. The reclamation of this land has occupied the attention of the Government of India for many years, but less effort has been made to utilise the soluble salts. Such lands have the following general features:

the soil is impermeable for a varying depth below the first few inches; below the impermeable layer is a coarser layer, more or less porous, in which nodular limestone is generally found, and this is sometimes so thick and continuous as practically to form a rock. The upper soil is thus shallow and fitted for the concentration of soluble salts. Such land varies in appearance according to its humidity and the amount of salts which it contains. Efflorescence is frequent, and a grey colour is general. An account of the various attempts which have been made to utilise *usar* land has been published in the Indian Agricultural Ledger (1901, No. 13) by W. H. Moreland, but analyses of the soluble salts contained in these soils have not been recorded, and no attempts have been made to extract these substances and employ them on a large scale. Out of the samples analysed, none contained less than 88 or 89 per cent. of sodium carbonate, but the percentage of salt in the soil varies very materially according to the district and the sub-soil. In the districts where there is a considerable quantity of alkali in the soil, the upper layers are collected and sold under the name of *sŭjji mŭttee.* This is used by native washermen in place of soap, and in Allahabad one tradesman makes a crude soap by boiling the solution of this earth with lime and castor oil.

Glass has also been made from this sodium carbonate, the chief product being the glass bangles which are so common in the country; sodium hydroxide has also repaid its manufacture, especially in the vicinity of paper mills. Both sodium carbonate and sodium hydroxide are, however, largely imported into India; the former, especially, being employed in the aëration of mineral waters.

It was thought that *reh* might be interesting from a chemical point of view, and it was examined in order to ascertain whether any sodium sesquicarbonate was present, since this substance occurs in other parts of the world as the native carbonates, *trona* and *urao.*

Each sample of earth was digested with hot water several times and the solution filtered. In each case, the light brown solution thus obtained yielded on evaporation large and well-defined crystals of the decahydrated normal carbonate, but fractional crystallisation gave a few monoclinic crystals imbedded in the solid mass produced by slowly evaporating the third fraction. These became opaque on being scratched and were possibly efflorescent.

The solution, which contained a considerable amount of humus, was evaporated to dryness on the water-bath, the residue being freely powdered and dried in a steam oven until the weight was constant. This was a long and tedious process; the weight diminished steadily for 48 hours, although less than half a gram of the substance was taken. There is therefore probably some hydrogen carbonate in the soluble salts. When the weight was constant, a combustion was made with the following result:

0·3892 gram gave 0·0278 CO_2 and 0·0078 H_2O with a residue of 0·3584 Na_2CO_3.

The loss in the dried sample was thus 0·0308 gram, or approximately 8 per cent., a result which was confirmed by igniting other portions of the dried salt in a weighed crucible.

Assuming that humus is half the weight of the CO_2 derived from it, and that the difference between the gain in the absorption tubes and loss in the combustion boat is due to oxidation of humus, we get 0·0048 gram of humus or 0·0096 gram of CO_2 due to humus. This leaves 0·0182 gram of CO_2 due to the decomposition of sesquicarbonate at red heat.

The corresponding quantity of sesquicarbonate is 0·1133, which would yield 0·0075 gram of water. The water found was 0·0078 gram. Hence the dried salt contained 29·9 per cent. of sesquicarbonate. The above experiments were made with the Pertabgarh sample.

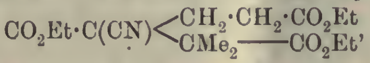
The soluble salts in five samples from different districts were analysed with the following results:

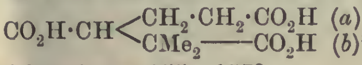
District.	Pertabgarh.	Benares.	Mirzapur.	Allahabad trans-Ganges.	Allahabad trans-Jumna.
Percentage of soluble salts.	6·3	3·1	16·6	6·3	6·5
Na_2O	57·70	57·72	56·70	57·60	57·61
CO_2	39·72	39·40	36·97	39·17	39·33
Al_2O_3	0·31	0·12	0·12	trace	trace
SO_3	—	—	5·26	2·32	1·71
Cl	2·06	2·67	0·73	0·77	1·06
P_2O_5	0 56	0·45	0·38	0·35	0·64
	100·35	100·36	100·16	100·21	100·37

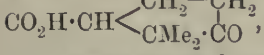
There were slight traces of silica and lime in each sample. These analyses indicate that the five samples have the following percentage compositions:

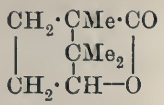
District.	Pertabgarh.	Benares.	Mirzapur.	Allahabad trans-Ganges.	Allahabad trans-Jumna.
Percentage of soluble salts.	6·3	3·1	16·6	6·3	6·5
Na_2CO_3	95·63	95·08	88·90	94·38	94·80
NaCl	3·39	4·40	1·20	1·21	1·75
Na_2SO_4	—	—	9·34	4·12	3·02
$\left.\begin{matrix}P_2O_5\\ Al_2O_3\end{matrix}\right\}$	as	above			

38. "Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid." By W. H. Perkin, jun., and J. F. Thorpe.

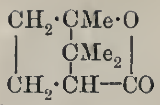
When ethyl cyanodimethylsuccinate, $CO_2Et\cdot CMe_2\cdot CH(CN)\cdot CO_2Et$, prepared by treating the sodium compound of ethyl cyanoacetate with ethyl bromo*iso*butyrate, is digested with sodium ethoxide and ethyl β-iodopropionate in alcoholic solution, *ethyl cyanodimethylbutanetricarboxylate*,  $CO_2Et\cdot C(CN)\Big<\begin{matrix}CH_2\cdot CH_2\cdot CO_2Et\\ CMe_2 \text{———} CO_2Et\end{matrix}$, is obtained as an oil which distils at 210—215° under 13 mm. pressure.

On hydrolysis with dilute sulphuric acid, this ester is converted into *dimethylbutanetricarboxylic acid*,  $CO_2H\cdot CH\Big<\begin{matrix}CH_2\cdot CH_2\cdot CO_2H\ (a)\\ CMe_2 \text{———} CO_2H\ (b)\end{matrix}$, a colourless, crystalline substance which melts at 155—157°.

When the trisodium salt of this acid is digested with acetic anhydride, carbon dioxide and water are eliminated between the two carboxyl groups (a) and (b), and *ketodimethylpentamethylenecarboxylic acid*,  $CO_2H\cdot CH\Big<\begin{matrix}CH_2-CH_2\\ CMe_2\cdot CO\end{matrix}$, is formed. This acid crystallises well, melts at 110°, yields an ethyl ester distilling at 172° (100 mm.), and a semicarbazone melting at 217°. The ethyl ester, when treated with magnesium methyl iodide in ethereal solution, is converted into a lactone which distils at 155—157° (50 mm.) and has a most penetrating odour of peppermint. This new lactone, for which the name iso*campholactone* is proposed, is isomeric with campholactone, and the close relationship which exists between these two substances is obvious when their formulæ are written side by side :



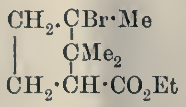
Campholactone.



iso*Campholactone.*

The above formation of *iso*campholactone constitutes the first synthesis of that trimethylpentamethylene ring which is the basis of camphoric acid and of so many other substances belonging to the camphor group, and it is hoped that it may ultimately be possible to obtain camphoric acid itself from this lactone.

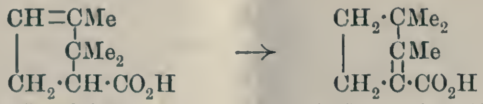
When the lactone is treated with phosphorus pentabromide and the product poured into alcohol, ethyl bromotrimethylpentamethylenecarboxylate is formed :



,

and is an oil which distils at 165—170° under 70 mm. pressure.

In an experiment in which this bromo-ester was heated with potassium cyanide in alcoholic solution, and then with alcoholic potash, a quantity of an oily acid was obtained which was obviously inactive α-campholytic acid, produced from the bromo-ester by elimination of hydrogen bromide and subsequent hydrolysis. This was proved by the fact that, on distillation with dilute sulphuric acid, the oil was converted into a crystalline acid melting at 132°, which, on examination, was easily identified as iso*lauronolic acid,* the well-known isomeric change indicated by the formulæ :



α-Campholytic acid. iso*Lauronolic acid.*

having taken place.

That the *iso*lauronolic acid, thus synthesised, is identical with *iso*lauronolic acid obtained from camphoric acid was shown by mixing equal quantities of the two preparations, when the mixture melted at 132°, the melting point of the constituents. Furthermore, the synthetical acid, on oxidation with permanganate, yielded *iso*lauronic acid.

39. "The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient." By J. C. Cain and F. Nicoll.

The authors have determined the temperature-coefficients by the use of Arrhenius's formula,

$$C_{t_1} = C_{t_0} e^{A(T_1 - T_0) : T_1 T_0},$$

the values of C being calculated from the formula

$$\frac{1}{t} \log \frac{A}{A - x} = C,$$

as indicated in their earlier communications (*Trans.*, 1902, **81**, 1412; 1903, **83**, 206).

The values of A for diazobenzene-*p*-sulphonic acid and the chlorides of diazobenzene, diazo-*o*-toluene, diazo-*m*-toluene, diazo-*p*-toluene, and diazo-*m*-nitrobenzene do not vary much from each other, and agree with those found by Euler (*Annalen*, 1902, **325**, 301) for diazobenzene chloride (11905) and diazo-*p*-bromobenzene chloride (13634). By the use of the temperature-coefficients thus obtained, the value of C at other temperatures has been calculated in several cases, and shown to be in agreement with the numbers found by other observers.

40. "An analysis of the natural gas at Heathfield, Sussex." By H. B. Dixon and W. A. Bone.

When the possibility of the industrial application of the Heathfield natural gas was brought before the Royal Commission on Coal Supplies, one of the authors (H. B. D., a member of the Commission) was asked to visit Heathfield and examine the nature of the gas on behalf of the Commission. Accordingly, several samples of gas were collected and sealed up in glass tubes on October 10th, 1902, and brought to Owens College for analysis.

According to Mr. Richard Pearson, Managing Director of the "Natural Gas Company," the gas was first discovered in 1836 in a well which was being sunk at Hawkhurst in West Sussex. In the Sub-Wealden boring (1873—1875), the gas was met with at Netherfield on the South Eastern Railway. Gas was first encountered at Heathfield in 1895 in sinking a well for water in the hotel yard, about 50 yards from the station. In 1896, the same firm of well-sinkers met the gas at a depth of 300 feet in a shaft sunk for water at the station; no water was found, but the gas continued to escape, and was then used for lighting the station.

At the date of the above visit, six wells were either sunk or in course of being sunk, and gas had been encountered in all of them after the bores had penetrated through the 300 or 400 feet of surface bed of sandstone and marl which forms, according to Mr. Pearson, the impervious lid to the natural holder of gas.

The gas was issuing from the bore-holes at a pressure of between 140 and 200 lbs. per square inch, and was being used to drive gas engines and to light (with incandescent mantles) the station and a number of houses in the village. When lighted at an inch pipe at the mouth of a bore-hole, the gas burnt with a large flame giving a fairly good light, the flame being more luminous than that of fire-damp from coal mines. In an argand burner, the gas burnt with a moderately luminous flame, but gave little light in an ordinary bats-wing, so that it was difficult to understand how the gas could contain 5½ per cent. of ethylene, as was stated, unless, indeed, the free oxygen, also said to be present, was sufficient to destroy its lighting power. The analyses, however, showed that neither ethylene nor free oxygen was present in the gas collected. To avoid the possible loss of free oxygen by partial combustion in the tube while the drawn-out ends were being sealed, a sample was collected by closing the ends of the tube with paraffined indiarubber; it gave the same result.

The gas was transferred by means of a Töpler pump from the collecting vessels into small tubes standing over mercury. The analyses were made over mercury in a modified McLeod apparatus, all the reagents being freshly prepared.

A. *Preliminary examination for carbon dioxide, oxygen, unsaturated hydrocarbons, and carbon monoxide.*

(1) The absence of carbon dioxide and oxygen was proved by exposing the gas successively to the action of (*a*) strong potassium hydroxide solution and (*b*) strongly alkaline pyrogallol solution. In neither case was there any appreciable absorption.

(2) The absence of unsaturated hydrocarbons was shown in two separate experiments in which samples of gas were successively treated with (*a*) fuming sulphuric acid and (*b*) strong potassium hydroxide solution. No change in volume occurred in either experiment.

(3) The gas always showed an appreciable contraction (as nearly as possible 1 per cent.) when successively treated with ammoniacal cuprous chloride and dilute sulphuric acid. No precipitate of cuprous acetylide was formed. Since the foregoing experiments exclude the possibility of this contraction being due to oxygen or unsaturated hydrocarbons, it can only be attributed to the presence of carbon monoxide.

B. *Explosion analyses for saturated hydrocarbons, with, possibly, hydrogen, after removal of carbon monoxide.*

After removing the carbon monoxide from a considerable volume of the gas (by means of ammoniacal cuprous chloride and dilute sulphuric acid), the contraction, C, obtained on exploding measured volumes of the residual gas with a large excess of oxygen and air, was determined, and also the absorption, A, when the products of explosion were subsequently treated with strong potassium hydroxide solution. The following results were obtained :

	1.	2.	3.
Volume of gas taken (corr.)......	48·25	55·70	58·75
Volume of oxygen and air added	457·45	468·30	465·45
C	94·35	109·10	115·20
A	48·25	55·90	58·80
C/A	1·956	1·952	1·959

C. *Proof that the gas does not contain free hydrogen.*

Before the foregoing results could be interpreted, it was necessary to ascertain whether the gas contained free hydrogen. This was done by exposing some of the gas, after removing carbon monoxide, to the action of "oxidised" palladium sponge at 100° for twenty minutes in an apparatus similar to that described by Bone and Jerdan (Trans., 1901, 79, 1044), and afterwards redetermining the ratio C/A, when the residual saturated hydrocarbons were exploded with excess of oxygen and air. The results obtained were as follows :

	4.	5.
Volume of gas taken (corr.)	62·3	55·3
Oxygen and air added..................	472·5	493·0
C	121·8	108·2
A	62·2	55·4
C/A	1·958	1·953

A comparison of these numbers with those given above shows clearly that the gas contains an appreciable quantity of free hydrogen. The five explosion analyses indicated, however, the presence, besides methane, of a small proportion of some higher saturated hydrocarbon which is probably ethane. Assuming this to be the case, the percentage composition of the gas, after removing carbon monoxide, calculated from the five analyses, is as follows :

	1.	2.	3.	4.	5.	Mean.
Methane...	94·10	93·88	94·40	94·30	93·90	94·10
Ethane ...	2·95	3·23	2·77	2·76	3·13	2·97
		Nitrogen, by difference.......................				2·93
						100·00

The original gas, therefore, had the following composition :

Carbon monoxide	1·00
Methane	93·16
Ethane	2·94
Nitrogen, or other inert gas (by difference)	2·90
	100·00

41. "Chemical composition of cooked vegetable foods." By Miss K. I. Williams.

The following constituents: water; total nitrogen (by Kjeldahl's method, modified to include the nitrogen of nitrates); ash; sulphur; phosphorus; cellulose (by Schulze's potassium chlorate method); woody fibre (by digestion with dilute sulphuric acid); carbohydrates convertible into dextrose; fat; and waste, were estimated in a series of vegetable foods including broccoli, Brussels sprouts, dried peas, oatmeal (coarse Scotch), and macaroni, these determinations being carried out on both the raw and the cooked materials.

42. "The density of nitric oxide. Preliminary notice." By R. W. Gray.

It seemed doubtful whether nitric oxide had been obtained in a state of sufficient purity to admit of the accurate determination of its density and other physical constants. The value obtained by Leduc (*Compt. rend.*, 1893, **116**, 322) for the density does not agree absolutely with the value found by Victor Meyer and Daccomo (*Annalen*, 1887, **240**, 326), while Olszewski's results (*Compt. rend.*, 1885, **100**, 940) for the vapour pressures of the liquefied gas certainly suggest the possibility of impurity in the sample he used.

Nitric oxide, when prepared by many of the usual methods, contains small quantities of nitrous oxide and nitrogen. The higher oxides of nitrogen which are generated at the same time are apparently completely absorbed when passed through tubes containing potassium hydroxide in solution and in the solid form, and the gas then liquefies to a blue liquid which does not change in tint after repeated fractionation. The nitrogen present cannot be entirely removed by solidifying the nitric oxide by means of liquid air and pumping off the uncondensed gas; a small quantity remains behind in the solid nitric oxide and can only be removed by liquefying and allowing a large portion of the liquid to boil away.

Owing to the ease with which liquid nitric oxide becomes superheated, it was found impossible to separate by fractionation the nitrous oxide present unless the upper part of the bulb containing the liquefied gas was kept below the melting temperature of solid nitrous oxide. When this was done, the densities of different fractions of the gas were found to agree.

The mean value for the weight of 1 litre of nitric oxide, prepared in two different ways, is 1·3402 grams at 0° and 760 mm. pressure (lat. Paris).

Until confirmed by further experiments, this value is not considered as final, but it is interesting to note that, assuming the truth of Avogadro's law for oxygen and nitric oxide under standard conditions of temperature and pressure, the ratio of the atomic weights so deduced for oxygen and nitrogen is 16 : 14·001.

The work is being continued with the object of making further experiments on the density of this gas and of determining its compressibility and other physical constants.

43. "Hydrolysis of urea hydrochloride." By J. Walker and J. K. Wood.

A comparison method was described which permits the hydrolysis of a salt such as urea hydrochloride to be determined by the catalysis of cane sugar or methyl acetate with an error not exceeding 1 per cent.; the results obtained with these two compounds being identical.

Within the limits 25—40°, temperature has practically no influence on the hydrolysis of urea hydrochloride.

The influence of dilution on the degree of hydrolysis x is expressed by the relation $\frac{x^2}{(1-x)v} = \text{constant}$.

The addition of sodium chloride very slightly diminishes the value of x.

The dissociation constant of urea, calculated from the hydrolytic experiments, is $1{\cdot}5 \times 10^{-14}$ at 25°.

44. "The affinities of some feebly basic substances." By J. K. Wood.

By means of the methyl acetate method, together with some solubility experiments, the author has obtained the following results at 40·2°:

Base.	Percentage hydrolysis of hydrochloride in decinormal solution.	Dissociation constant	Base.	Percentage hydrolysis of hydrochloride in decinormal solution.	Dissociation constant.
Creatinine	8·96	$3{\cdot}57 \times 10^{-11}$	Dimethylpyrone	85·0	$0{\cdot}0065 \times 10^{-11}$
Acetoguanamine..	9·8	2·96 ,,	Xanthine	88·5	0·0046 ,,
Semicarbazide ...	10·4	2·61 ,,	Acetanilide......	88·9	0·0044 ,,
Glycocyamine ...	11·0	2·32 ,,	Caffeine	89·7	0·0040 ,,
Creatine	12·3	1·81 ,,	Urea	90·4	0·0037 ,,
Guanine	17·9	0·81 ,,	Acetamide	91·3	0·0033 ,,
			Nitroguanidine	94·0	0·0021 ,,
Acetonesemicarbazone	26·9	0·32 ,,	Propionitrile ...	97	—
Acetoxime	34·3	0·175 ,,	Cyneol............	98	—
Aminocaffeine ...	55·0	0·047 ,,	Biuret	>99	—
Theobromine	73·0	0·016 ,,	Benzamide	>99	—

ADDITIONS TO THE LIBRARY.

I. Donations.

Cohen, Julius Berend. Theoretical organic chemistry. London 1902. From the Author.

Gregory, William. A handbook of inorganic chemistry, being a new and greatly enlarged edition of the "Outlines of inorganic chemistry." 3rd ed. ill. London 1853. From the Lawes Trust.

Lang, H. Das chemische Laboratorium an der Universität in Heidelberg. ill. Carlsruhe 1858. From the Lawes Trust.

Low, David. An inquiry into the nature of the simple bodies of chemistry. 2nd ed. London 1848. From the Lawes Trust.

Marignac, Jean-Charles Galissard de. Œuvres complètes, publiées hors série sous les auspices de la Société de physique et d'histoire naturelle de Genève: par E. Ador. vol. ii. Mémoires et critiques, 1860—1887. Geneva 1903. From the Family.

Parkes, Samuel. A chemical catechism for the use of young people: with copious notes for the assistance of the teacher, to which are added a vocabulary of chemical terms, useful tables, and a chapter of amusing experiments. ill. London 1806. From the Lawes Trust.

Violette, J. H. M., and Archambault, P. J. Dictionnaire des analyses chimiques, ou répertoire alphabétique des analyses de tous les corps naturels et artificiels depuis l'origine de la chimie jusqu'a nos jours, avec l'indication du nom des auteurs et des recueils où elles ont été insérées. 2 vols. Paris 1851. From the Lawes Trust.

Weltzien, Karl, and Lang, H. Das chemische Laboratorium an der grossherzogl. polytechnischen Schule zu Carlsruhe. ill. Carlsruhe 1853. From the Lawes Trust.

II. By Purchase.

Schnabel, Carl. Lehrbuch der allgemeinen Hüttenkunde. 2nd ed. ill. Berlin 1903.

Hoppe-Seyler, Ernst Felix Immanuel. Handbuch der physiologisch- und pathologisch-chemischen Analyse für Aerzte und Studirende. Edited by H. Thierfelder. 7th ed. ill. Berlin 1903.

Liebrich, Oscar. Ueber die Wirkung der Borsäure und des Borax. (Ein zweites Gutachten.) ill. Berlin 1903.

Lüpke, Robert. Grundzüge der Elektrochemie auf experimenteller Basis. 4th ed. ill. Berlin 1903.

III. Pamphlets.

Borns, Henry. Die Elektrochemie im Jahre 1896 (1897—1901).

Citron or Cedrat Oil (Citrus Medica). A review of recent research work on the constants of this oil. 1903.

Harrison, John Burchmere. Report on the agricultural work in the Botanic Gardens and the Government Laboratory for the years 1896—1901. British Guiana, Georgetown, Demerara 1902.

Van Slyke, L. L., and Hart, E. B. Some of the compounds present in American Cheddar Cheese (*being Bull. No.* 219, *New York Agric. Exper. Station*). 1902.

Collins, Sidney Hoare. Composition of Milk in the North of England. London 1903.

Collins, Sidney Hoare. Sugar in Swedes. Part II. London 1903.

Stocks, Herbert Birtwhistle, and H. Graham White. Sizing and sizing materials. London 1903.

Patten, Harrison Eastman. Influence of the solvent in electrolytic conduction. 1902.

Freer, Paul C. The preparation of benzoylacetylperoxide, and its use as an intestinal antiseptic in cholera and dysentery. Manila 1902.

Taylor, Robert Llewellyn. On the reaction of iodine with mercuric oxide in presence of water. Manchester 1902.

Smith, Alexander, and Holmes, Willis B. On amorphous sulphur. (Univ. of Chicago Decennial Publications.) Chicago 1902.

Cutolo, Alessandro. Contributo all' analisi degli olii. (*From the Bull. Soc. Nat. Napoli*, 15, 1901.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 25th, 1903** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

The Secretaries will be glad to have, at as early a date as possible, the names of Fellows and their guests who propose to dine. All applications for tickets must be received not later than **Wednesday, March 18th.**

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday,** March 25th, at **half past four** o'clock in the afternoon.

At the next meeting, on **Wednesday,** March 18th, 1903, at **5.30** p.m., the following papers will be communicated:

"Essential oil of hops." By A. C. Chapman.

"A compound of dextrose with hydroxide of aluminium." By A. C. Chapman.

"Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin." By A. W. Crossley and P. Haas.

"The constitution of cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

"The decomposition of mercurous nitrite by heat." By P. C. Rây and J. N. Sen.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 263.

Wednesday, March 18th, 1903. Professor J. Emerson Reynolds, Sc.D., F.R.S., President in the Chair.

Messrs. J. M. Wadmore, J. Phelps, and F. Soddy were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William Lester St. John Alton, Dungarvan, Putney Heath, S.W.
Henry Gough, c/o. Messrs. J. Lovibond & Sons, Ltd., Greenwich, S.E.
William Kirkby, Winster House, Thornfield Road, Heaton Moor.
John George Collcutt Lock, 17 Berners Street, W.
George G. Pond, M.A., Ph.D., State College, Pennsylvania, U.S.A.
Robert James Porter, 11, Arlington Street, Hull.
Ernest William Sawdon, B.Sc., 2, Esk Terrace, Whitby.
Giles Hadden Welsford, 6, The Orchard, Blackheath, S.E.

The PRESIDENT stated, in reference to a petition which had been recently presented to the Council, that he had the authority of the Council to communicate to the Society the terms of the petition and of the resolution of the Council with regard to it. The terms of the petition were:

"We, the undersigned Fellows of the Chemical Society, being of opinion that the interests of the general body will be promoted by limiting the period of service of the Honorary Secretaries and Foreign Secretary, do hereby request the Council to earnestly consider the desirability of so limiting the tenure of office."

The resolution passed by the Council *nem. con.*, which was duly communicated to Mr. C. E. Groves, who represented the petitioners, was "That this Council is of opinion that the tenure of office of the Officers of the Society should not be indefinitely extended, but that it is not desirable to limit the period by assigning a definite term of years to the tenure of each office."

Of the following papers those marked * were read:—

*45. "Essential oil of hops." By A. C. Chapman.

Since the publication of the earlier results of the study of oil of hops (*Proc.*, 1893, 177; *Trans.*, 1895, 67, 54, and 780), three more samples of oil of undoubted genuineness have been examined. These had the following specific gravities and specific rotations:

	Sp. gr. 15°/15°.	Sp. gr. 20°/20°.	$[\alpha]_D^{20°}$.
No. 5..............	0·8676	0·8645	+0·30°
No. 6.....	0·8639	0·8610	−0·20°
No. 7......	0·8403	0·8357	−0·08°

The fraction of lowest boiling point, obtained after prolonged fractional distillation under reduced pressure, consisted of a hydrocarbon $C_{10}H_{16}$, which had the following properties: sp. gr. 0·8046 at 15°/15° and 0·8020 at 20°/20°; b. p. 74—75° (33 mm.) and 166—168° (774 mm.), undergoing at the same time slight polymerisation. It was optically inactive and had a refractive index 1·4645 at 20° and a molecular refraction 46·8, the calculated number for $C_{10}H_{16}$ (with 3 double linkings) being 46·78. This compound is therefore an aliphatic hydrocarbon, and its properties are almost identical with those of myrcene; it absorbs oxygen from the atmosphere and readily undergoes polymeric change, becoming converted into a colourless resin.

The next fraction (b. p. 120—130°, 46 mm.) was a very small one, and gave on analysis numbers agreeing with the formula $C_{10}H_{18}O$. It had a sp. gr. 0·8571 at 20°/20°, produced a rotation of −0°40′ in a

100 mm. tube, and evidently consisted of inactive linalool mixed with a small quantity of some active substance.

The third small fraction (b. p. 135—150°, 46 mm.) consisted of an ester, and yielded on saponification *iso*nonoic acid, $C_9H_{18}O_2$, and linalool, together with a small quantity of geraniol.

The highest and largest fractions in all three samples of oil consisted of nearly pure humulene. On submitting the oil to the action of boiling chromic acid mixture, it yielded acetic, valeric, succinic, unsymmetrical dimethylsuccinic (m. p. 140°), and *iso*nonoic acids, the last of these having been probably derived from the linalyl ester. When dilute nitric acid was employed in the oxidation, oxalic and acetic acids were the chief soluble products of acidic character.

Oxidation experiments made with the fractionated constituents of the oil showed that the dimethylsuccinic acid is derived from the humulene, and succinic acid from the myrcene.

The essential oil of hops therefore contains the following compounds: myrcene, humulene, linalool, linalyl *iso*nonoate, with small quantities of a diterpene and probable traces of some ester of geraniol.

In all the freshly distilled samples of oil examined, the hydrocarbons myrcene and humulene were present to the extent of from 80 to 90 per cent.

DISCUSSION.

Dr. POWER remarked that the results obtained by Mr. Chapman seemed to leave no doubt respecting the identity of the hydrocarbon of low boiling point contained in hop oil with the myrcene of oil of bay. Attention was also called to the fact that, apart from the interest connected with the general properties of myrcene and the occurrence of such an olefinic terpene in nature, it has recently been utilised in a study of the chemical composition of Para rubber. Harries (*Ber.*, 1902, 35, 3259) has shown that when rubber is treated with nitrous acid it yields a series of nitrosites, one of which has the molecular composition $(C_{10}H_{15}O_7N_3)_2$, and appears to be identical in every respect with a nitrosite obtained from a product of the polymerisation of myrcene termed dimyrcene, $C_{20}H_{32}$. It is thus rendered probable that myrcene stands in very close relationship to isoprene and caoutchouc.

In reply to Professor Tilden, Mr. CHAPMAN said that he had not obtained any evidence of the existence of pinene in the oil. The slight optical activity was, in all probability, due to the presence of a small quantity of active linalool, but the intermediate fractions were so small, even when working with considerable quantities of the oil, that it was impossible to arrive at a definite conclusion in regard to this point.

*46. "A compound of dextrose with aluminium hydroxide." By A. C. Chapman.

The author has obtained a compound of dextrose with aluminium hydroxide by the following process.

To a solution of 8 grams of pure anhydrous aluminium chloride in about 1500 c.c. of 90 per cent. alcohol, powdered dextrose was added until it no longer dissolved after allowing the mixture to remain some time in a warm place. The white, gelatinous precipitate immediately produced by adding aqueous ammonia in slight excess to the filtered solution was collected, washed with 90 per cent. alcohol, and dried until of constant weight in an exhausted desiccator over sulphuric acid. It was not found possible by repeated washing to remove the last trace of chlorine, a small quantity invariably remaining, apparently in the form of a basic chloride. By careful treatment it is, however, possible to obtain a preparation which, after drying, will not contain more than 0·2 to 0·5 per cent. of chlorine.

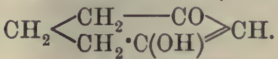
Many different preparations of this compound were made with slightly varying proportions of dextrose and aluminium chloride. The analytical results, although fairly concordant, do not correspond with any simple formula:

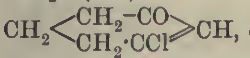
(1) 0·6010 gave 0·376 CO_2 and 0·276 H_2O. $C=17·06$; $H=5·10$.
(2) 0·4270 „ 0·275 CO_2 „ 0·196 H_2O. $C=17·56$; $H=5·08$.
(3) 0·4135 „ 0·264 CO_2 „ 0·185 H_2O. $C=17·41$; $H=4·96$.
(4) 0·6010 „ 0·250 Al_2O_3; $Al=22·01$.
Three other estimations gave $Al=22·12$, 22·18, and 22·34.
$[3C_6H_{12}O_6,5Al_2O_3,11H_2O]$ requires $C=17·39$; $H=4·67$; $Al=21·80$ per cent.

From these results, it appears probable that the white, flocculent precipitate is a compound of 3 mols. of dextrose with 5 mols. of aluminium hydroxide $[3C_6H_{12}O_6,5Al_2(OH)_6]$, and that this compound, when dried in an exhausted desiccator over sulphuric acid, loses approximately 4 molecules of water (compare *Trans.*, 1889, **55**, 576; 1891, **59**, 224).

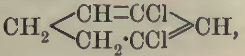
This aluminium compound is a white, amorphous substance, insoluble in water and alcohol, but dissolving in dilute acids. It differs from the similar compounds of dextrose with the oxides of iron and chromium in being insoluble in water when freshly precipitated; with boiling water, it undergoes partial decomposition into aluminium oxide and dextrose. On drying for some hours at 100°, the substance lost 12 per cent. of its weight and acquired a pale yellow colour, but did not char appreciably at this temperature; it burned with extreme readiness when heated more strongly, yielding a mixture of the metallic oxide mixed with carbon, the final residue after prolonged ignition consisting of aluminium oxide.

*47. "Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin." By A. W. Crossley and P. Haas.

Dihydroresorcin behaves towards phosphorus haloids in a similar way to its dimethyl derivative (*Trans.*, 1903, 83, 110), in fact, as if it possessed the following formula :  $\mathrm{CH_2}<\begin{array}{l}\mathrm{CH_2{-}{-}CO}\\ \mathrm{CH_2\cdot C(OH)}\end{array}>\mathrm{CH}$.

5-*Chloro-3-keto-Δ⁴-tetrahydrobenzene*,  $\mathrm{CH_2}<\begin{array}{l}\mathrm{CH_2{-}CO}\\ \mathrm{CH_2\cdot CCl}\end{array}>\mathrm{CH}$, obtained by the action of phosphorus trichloride on dihydroresorcin, is a colourless, highly refractive liquid boiling at 104° (24 mm.); it gives a *semicarbazide* melting at 190° and on oxidation is converted into glutaric acid.

The corresponding *bromo*-derivative boils at 132·5—133° (52 mm.).

Phosphorus pentachloride gave rise to 3:5-*dichloro-Δ²˒⁴-dihydrobenzene*,  $\mathrm{CH_2}<\begin{array}{l}\mathrm{CH{=}CCl}\\ \mathrm{CH_2\cdot CCl}\end{array}>\mathrm{CH}$, a colourless, refractive liquid boiling at 88—90° (29 mm). On treatment with excess of phosphorus pentachloride or with bromine, it was converted into *m*-dichlorobenzene, and on reduction with sodium in moist ethereal solution, yielded a mixture of di- and tetra-hydrobenzenes. This mixture of hydrocarbons readily absorbed two atoms of bromine, and the resulting liquid deposited crystals of *dibromodihydrobenzene*, $C_6H_8Br_2$, which separated from light petroleum in transparent, hexagonal prisms melting at 104·5°, and decomposing at 170° with evolution of hydrogen bromide.

*48. "The constitution of cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

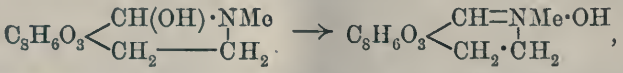
Although previous investigators are in agreement as to the possible existence of the carbinol form of cotarnine, the question as to whether this constitution or one expressed by an open chain formula should be assigned to solid cotarnine has hitherto remained unsettled. A satisfactory answer has now been furnished by the study of the absorption spectra of this substance and its derivatives. Solid cotarnine begins to undergo a constitutional change as soon as it comes into contact with water or alcohol, but is not altered either by ether or chloroform, and the spectra of the ethereal and chloroform solutions, which may therefore be regarded as the true spectra of cotarnine, agree perfectly with one another and also with those of hydrocotarnine and its salts; moreover, they are identical with those of the cyanide and ethoxyhydrocotarnine, these substances having been regarded as derivatives of the carbinol form.

The spectra of dilute aqueous or alcoholic solutions of cotarnine and those given by a solution of cotarnine hydrochloride from which the chlorine has been removed by means of silver oxide are almost identical with the spectra of cotarnine hydrochloride, which, on the other hand, differ widely from the spectra of cotarnine in ether.

Cotarnine and all its derivatives hitherto examined spectroscopically conform to one or other of these two forms of spectra. (i) The spectra of cotarnine in aqueous or alcoholic solution and of cotarnine salts show a large amount of general absorption with two well-marked absorption bands, one of which is close to the visible region. (ii) The spectra of cotarnine in ether or chloroform, hydrocotarnine, ethoxycotarnine, and cotarnine cyanide show less general absorption than the former, and have a band much further removed from the visible region.

The substances in the first class are yellow, those in the second are colourless; the latter can all be represented as having a carbinol constitution.

When cotarnine is dissolved in anhydrous alcohol, it changes from the carbinol to the quaternary ammonium hydroxide form,



$$C_8H_6O_3{<}\begin{matrix}CH(OH)\cdot NMe\\ CH_2\text{——}CH_2\end{matrix} \rightarrow C_8H_6O_3{<}\begin{matrix}CH{=}NMe\cdot OH\\ CH_2\cdot CH_2\end{matrix},$$

the rearrangement being promoted either by increasing the mass of the alcohol present or by heating. The transformation is effected much more rapidly by methyl than by ethyl alcohol.

A colourless solution of cotarnine in alcohol cannot be obtained, but, since this isomeric change proceeds slowly, it is possible in ethyl alcohol, by photographing the freshly prepared solution immediately, and again after successive intervals of time, to trace the transformation through all its phases. The rate of progress of the change may even be determined by comparing photographs of the alcoholic solution with those of the spectra of mixtures of the solutions of the hydrochloride (ammonium form) and the cyanide (carbinol form) in known proportions. Potassium, sodium, and barium hydroxides, and even ammonia, promote the reverse change to that effected by alcohol. When cotarnine hydrochloride in solution is decomposed by sodium hydroxide, the cotarnine changes at once to the carbinol form, but if an aqueous solution of cotarnine is treated with successively larger quantities of this alkali, the reverse change is gradual, and, as in the case of the opposite change induced by alcohol can be distinctly traced through its various phases. These results explain several of the peculiarities observed by Hantzsch and Kalb (*Ber.*, 1899, 32, 3109) in their experiments on the conductivity of cotarnine.

Preliminary experiments indicated that similar results are given by hydrastinine.

DISCUSSION.

Mr. **BALY** said that an interesting comparison could be drawn between these absorption spectra of cotarnine compounds and those obtained by Hartley and Dobbie with derivatives of *o*-oxycarbanil. In the latter case, the lactam esters correspond to the derivatives from the ammonium hydroxide form of cotarnine and the lactim esters to the derivatives from the carbinol form. The absorption spectra of the lactim esters of *o*-oxycarbanil and of the ammonium hydroxide form of cotarnine both have more general absorption with the absorption band nearer to the visible region than in the case of the spectra of the lactim esters of *o*-oxycarbanil and the carbinol form of cotarnine. This contrast appears to be the opposite of that observed in the keto- and enolic forms of carbon compounds.

Dr. **ORTON** asked whether the addition of a small quantity of alcohol to the ethereal solution of cotarnine, in which the alkaloid was present in the carbinol (or pseudo-ammonium) form, effected a *complete* conversion of the carbinol into the true ammonium base; or was, on the other hand, a point of equilibrium reached which was only displaced by addition of a further quantity of alcohol? As the presence of small quantities of bases such as piperidine has such a marked influence on similar isomeric changes, preventing the change of a non-basic into a basic substance and facilitating the reverse process, it would be of interest to know whether any similar observations on the transformation of cotarnine under the influence of alcohol had been made.

In reply to Mr. Baly, Professor **DOBBIE** stated that no such general relation between the absorption spectra of lactams and lactims, as seemed to be implied in the question, had been established.

With reference to Dr. Orton's question, he stated that the amount of change produced by sodium hydroxide in an aqueous solution of cotarnine was found to be proportional to the quantity of caustic alkali added, when the solution was examined immediately after the addition of this reagent. The effect of time on the alkaline solution had not yet been fully investigated.

*49. "Decomposition of mercurous nitrite by heat." By P. C. Rây and J. N. Sen.

When mercurous nitrite was decomposed by heat in a tube connected with a Sprengel pump, nitric oxide escaped mixed with very little nitrogen peroxide, crystals of mercurous nitrate were projected across the upper and cooler part of the tube, just over the decomposing salt, a very little metallic mercury and its basic nitrate were deposited at the sides, whilst a small quantity of amorphous, orange-coloured mercuric oxide was left in the place of the decomposed nitrite. Except when the greater portion of the nitrate which had formed at first had been decomposed by heating more strongly, the average amount of nitric oxide produced corresponded with only 3·3 out of the 5·7 per cent. of nitrogen contained in the nitrite.

The production of mercurous nitrate was evidently due to interaction between nitrogen peroxide and mercury vapour, nitric oxide being the other product. In decomposing, the mercurous nitrite behaves partly as if it had a non-oxylic constitution in yielding mercury and nitrogen peroxide, and partly as if it had an oxylic constitution in giving rise to mercuric oxide and nitric oxide.

Discussion.

Dr. Divers said that the authors' observation of the conversion into crystals of mercurous nitrate of the nitric peroxide and mercury vapour coming from the mercurous nitrite was very interesting and recalled the production of crystals of mercurous chloride from a mixture of mercury vapour, air, and hydrochloric acid, which occurred in the manufacture of that substance in the old Japanese way. It also strikingly confirmed, as the authors had pointed out, the accuracy of the account of the decomposition of silver nitrite, given by Shimidzu and himself years ago. He considered the authors to be mistaken as to the origin of the small quantity of mercuric oxide, which was always produced. That this formed just where the mercurous nitrite had lain was not that the nitrite had directly decomposed into mercuric and nitric oxides, but that, by the use of a small flame as applied, this spot was the only part of the tube sufficiently hot to bring about the well-known decomposition into this oxide of the mercurous nitrate which was forming out of the gas and vapour, equally and as much here as in the upper and cooler part of the tube.

50. "The action of nitrogen tetroxide on pyridine." By J. F. Spencer.

In attempting to nitrate pyridine, the author studied the action of nitrogen tetroxide on this base, and although nitropyridine was not isolated an isomeride was produced. The nitrogen tetroxide, which was prepared by the direct combination of nitric oxide and oxygen, was employed either in the gaseous form or as a liquid at low temperatures; but these variations of the experimental conditions did not materially affect the course of the reaction, which gave rise to the same product whether the base was treated alone or in the presence of various solvents.

The first product is an unstable, white, crystalline compound which was shown by analysis to be an additive compound of pyridine and nitrogen tetroxide. The further action of the latter reagent led to the production of a solid, black substance, which, when treated with water, entirely dissolved, yielding a brownish-red solution; this solution, on further dilution, gave a yellow, amorphous deposit (i) amounting to about 4 per cent. of the pyridine taken. The filtrates, when rendered alkaline, furnished 70 per cent. of unaltered pyridine, but no other basic substance. If, however, the alkaline solution was acidified, it gave a purplish-brown precipitate (ii), the composition of which was not determined.

(i) The yellow product, which is insoluble in all the ordinary organic solvents except pyridine, dissolves in mineral acids or aqueous alkalis forming deep red solutions; when rapidly heated, it decomposes explosively at 234°; on distillation with zinc dust, it yields pyridine:

0·1986 gave 0·3530 CO_2 and 0·0568 H_2O. C = 48·66; H = 3·19.
0·0691 ,, 13·44 c.c. moist nitrogen at 13° and 764·6 mm. N = 22·77.
$C_5H_4O_2N_2$ requires C = 48·38; H = 3·22; N = 22·58 per cent.

These results were confirmed by many additional analyses. The hydrochloric acid solution of this substance yielded a platinichloride containing 13·53 per cent. Pt. Calculating the molecular weight of the polymeride from this result, the value 521 is obtained; this corresponds with the molecular formula $(C_5H_4O_2N_2)_4$, which has a molecular weight 496. All attempts to depolymerise this substance failed; mild reducing agents had no action, although tin and hydrochloric acid reduced it to a basic compound, the platinichloride of which contained 31·49 per cent. Pt, whilst $(C_5NH_4{\cdot}NH_2)_2H_2PtCl_6$ requires 32·6 per cent. Pt.

(ii) The purple substance somewhat resembles the yellow compound, but is evidently more complex.

The unsatisfactory yields and the highly complex nature of the products have rendered it impossible to pursue this investigation.

ADDITIONS TO THE LIBRARY.

I. Donations.

Reynolds, Osborne. The sub-mechanics of the universe. Published for the Royal Society of London. Cambridge 1903.
From the Author.

Weinberg, Boris. L'enseignement pratique de la physique dans 206 laboratoires de l'Europe, de l'Amerique, et de l'Australie. Odessa 1902. From the Author.

Henri, Victor. Lois générales de l'action des diastases. Paris 1903. From the Author.

Plimmer, Robert Henry Aders. The chemical changes and products resulting from fermentations. London 1903.
From the Publishers.

Nilson, Lars Fredrik, and Jolin, Severin. Minnesfesten öfver Berzelius den 7 Oktober 1898. Beskrifning på uppdrag af kungl. vetenskaps akademien. Stockholm [1901]. From the Academy.

Clowes, Frank, and Coleman, Joseph Bernard. Quantitative chemical analysis, adapted for use in the laboratories of colleges and schools. 6th ed. ill. London 1903. From the Publishers.

At the next ordinary meeting, on **Thursday**, April 2nd, 1903, at **8 p.m.**, the following papers will be communicated:

"On the absorption spectra of nitric acid in various states of concentration." By W. N. Hartley.

"The dioximes of camphorquinone and other derivatives of *iso*nitrosocamphor." By M. O. Forster.

"Salts of a mercaptoid isomeric form of thioallophanic acid, and a new synthesis of iminocarbaminethioalkyls." By A. E. Dixon.

"Discoloured rain." By E. G. Clayton.

"Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone." By F. D. Chattaway.

"Reversibility of enzyme or ferment action." By A. C. Hill.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 264.

March 25th, 1903. Annual General Meeting. Professor J. EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

Dr. L. T. Thorne and Dr. K. J. P. Orton were appointed Scrutators, and the ballot was opened for the election of Officers and Council for the ensuing year. The President then presented the following Report on the state of the Society during the past twelve months:

REPORT OF THE COUNCIL.

The Council have the satisfaction of announcing that the numerical strength of the Society which, on March 26th, 1902, was 2416, is now 2471, the highest number yet reached. Since the last Annual General Meeting, 130 Fellows have been elected and 6 have been reinstated by the Council, making a gross total of 2552. Of these, 27 have been removed for non-payment of two subscriptions, 33 have withdrawn, and 21 have died, making 55 the net increase in the number of Fellows.

By the death of Professor J. Wislicenus, F.R.S., the number of Foreign Fellows has been reduced to 31.

The following Fellows have withdrawn :

A. Abbott.
C. Armitage.
W. P. Ashe.
C. R. Blackett.
H. V. Buttfield.
A. W. Clayden.
A. H. Downes.
J. Dunn.
L. Ehrmann.
G. Evans.
E. I. G. Gill.
R. H. C. Gompertz.
H. W. Gough.
J. P. Jenkins.
T. Judge.
J. Lunt.
W. B. Mason.
C. K. Millard.
J. L. Notter.
T. H. Page.
W. Pullinger.
J. C. Quinn.
J. Robinson.
W. Russell.
S. P. Sadtler.
J. Spilsbury.
T. C. Squance.
R. W. Steel.
D. R. Steuart.
W. Taylor.
A. Thomson.
Rev. W. Watson.
C. W. T. Woods.

The following Fellows have died :

Sir F. A. Abel, Bart., F.R.S.
Dr. C. M. Aikman.
F. B. Benger.
C. R. Blackett.
Prof. G. Bischof.
Dr. E. Demarçay.
W. C. Forsyth.
T. E. Gee.
Dr. J. H. Gladstone, F.R.S.
G. Griffith.
Prof. J. J. Hummel.
R. Jackson.
W. I. Macadam.
J. Moss.
J. Robbins.
Sir W. C. Roberts-Austen, K.C.B., F.R.S.
Dr. E. Schunck, F.R.S.
J. Sim.
W. H. Stanger.
E. Truman.
M. Zingler.

The scientific work of the Society during the past session abundantly testifies to its continued activity. Since the last Annual General Meeting, 189 scientific communications have been made to the Society, 118 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The *Transactions* for 1902 contains 160 memoirs occupying 1604 pages, whilst the volume for the preceding year contains 146 memoirs which occupy 1411 pages. In addition, the volume for 1902 contains the Raoult Memorial Lecture.

The *Journal* for 1902 contains also 3854 abstracts of papers published mainly in foreign journals, which extend to 1564 pages. These abstracts may be classified as follows :—

	Pages.	No. of Abstracts.*
Part I.		
Organic Chemistry	852	1632
Part II.		
General and Physical Chemistry		409
Inorganic Chemistry		428
Mineralogical Chemistry		154
Physiological Chemistry..		421
Chemistry of Vegetable Physiology and Agriculture		281
Analytical Chemistry		529
	712	2222
Total in Parts I and II	1564	3854

The Council desires to offer the congratulations of the Society to Professor G. D. Liveing, F.R.S., and to Mr. J. G. Hepburn, who this year reach the Fiftieth Anniversary of their election as Fellows.

The Society has to lament the death of one distinguished Foreign Fellow, Professor J. Wislicenus, F.R.S., and of twenty-one Fellows, amongst whom are two Past Presidents, Sir F. Abel, Bart., F.R.S., and Dr. J. H. Gladstone, F.R.S., who had been Fellows for the long period of fifty-five years; other notable names are those of Sir W. C. Roberts-Austen, K.C.B., F.R.S., Professor J. J. Hummel, and Dr. E. Schunck, F.R.S. Obituary notices of these will appear in the Journal.

The Raoult Memorial Lecture was delivered before a large audience in the Theatre of the Royal Institution (the use of which was kindly granted for the occasion by the Managers) on March 26th, 1902, by Professor J. H. van't Hoff, F.R.S.

The Council are glad to be able to announce that Professor W. H. Perkin, F.R.S., has undertaken to deliver the Wislicenus Memorial Lecture towards the end of the present year.

The Society, in conjunction with the Royal Society and the other Scientific Societies having rooms in Burlington House, arranged for the decoration and illumination of the Building on the occasion of the Coronation of the King.

The plan of holding the Ordinary Meetings of the Society alternately on Wednesdays, at 5.30 p.m., and on Thursdays, at 8 p.m., which was tried for the first time last session, proved so satisfactory that the Council determined to continue the practice during the present session. Both sets of meetings have been equally well attended, and the meetings held on Wednesdays appear, in particular, to suit the convenience of Fellows resident at a distance from London.

The Joint International Committee on Atomic Weights, on which the Society is represented by Professor Thorpe, has issued its first Report. This report, which includes a new table of atomic weights, has been printed in full, both in the *Journal* and the *Proceedings.*

The Society having been invited by the Organising Committee of the Fifth International Congress of Applied Chemistry to co-operate with other societies in this country in securing a proper representation of English chemistry, the Council, in June last, appointed a committee to take action in the matter, and have nominated, as its Delegates to represent the Society at the meeting of the Congress in Berlin in June next, the following Fellows: Professor W. A. Tilden, Professor W. R. Dunstan, Professor W. H. Perkin, and Dr. A. Scott.

A petition has been addressed to the Council requesting them to consider the desirability of limiting the period of service of the Honorary Secretaries and of the Foreign Secretary. The Council having fully considered the matter, passed, *nem. con.*, a resolution stating that whilst the tenure of office should not be indefinitely extended, it was not expedient to fix a definite term of years to the tenure of these offices.

The rapid growth of the Library rendered it imperative that additional accommodation for its extension should be obtained at once. This has been accomplished by utilising for that purpose some of the rooms of the basement, and plans are at present under consideration by which storage accommodation there for the less used books may allow of the normal growth of the Library for another ten or twelve years without its being unduly cramped. This, along with the constantly increasing amount of work entailed by the continuous growth and prosperity of the Society, rendered necessary the rearrangement of the duties of the Staff. After careful consideration, the Council decided to separate the duties of Assistant Secretary from those of the Librarian and Curator, Mr. Steele retaining the latter, whilst Mr. S. E. Carr has been appointed Assistant Secretary.

A complete card catalogue of the Library has now been made, and the new Catalogue, arranged both according to authors and subjects, was issued at the beginning of the present year at the price of half-a-crown. The Library continues to be increasingly used by the Fellows. 925 books were borrowed during the year as against 873 in the previous year. The additions to the Library comprised 64 books, 338 volumes of periodicals, and 23 pamphlets, the corresponding numbers of which in the year before were 153, 441, and 33 respectively. Of the books, 48 have been presented to the Society.

Grants amounting in all to £230 have been made from the Research Fund.

The Council here desires to place on record its high appreciation of the conspicuous services of Professor Dunstan, who now retires from the post of Honorary Secretary which he has held with such advantage to the Society, and who, for the last ten years, has given unsparingly both his time and his energy to the promotion of its highest interests. As one of the Vice-Presidents, the Council hope to have him among them for some time to come.

Another material change in the administrative officers of the Society comes into force with the nomination of the Treasurer, Professor Tilden, to the highest office in the Society, that of President. The Council acknowledges with gratitude the skill and foresight with which, for the last four years, he has controlled the finances of the Society, and it is largely owing to his management, as well as to the ever increasing prosperity of the Society, that the Council has been able to introduce several important reforms and rearrangements. These are alluded to elsewhere in this report, and it is hoped that they will greatly increase the usefulness of the Society.

Professor W. P. Wynne found it necessary, to the great regret of the Council, to resign the post of Editor of the *Journal* which he has held for the last four years with such credit to the Society, but kindly consented to act as Editor until the end of 1902, when he was succeeded by Dr. G. T. Morgan, who, in addition to editing the *Journal*, now edits the *Proceedings* of the Society.

REPORT OF THE TREASURER.

The Treasurer, in presenting the balance sheet for the year, stated that the net income was £6212 5*s*. 1*d*., whilst the expenses had been £5384 18*s*., leaving a surplus of £827 7*s*. 1*d*., which was about one hundred pounds less than the surplus income in 1902. This was due to several causes, namely, the increase of nearly £380 in the cost of the *Journal* and *Proceedings*, the additions to the item of salaries and wages, and the expenses on account of the Collective Index. Whilst, therefore, the present surplus is satisfactory in that it exceeds the amount paid into the account in the form of compositions and admission fees, all these three forms of expenditure will still require careful watching. Three years ago, at the end of his first year as Treasurer, he made an appeal to authors of papers with reference to the preparation of copy for the printers, and he could not help thinking that in the near future more stringent regulations in regard both to the state of the manuscript and the dimensions of papers would have to be imposed with the object of keeping the cost of printing within the means at the disposal of the Society. The Abstracts of foreign and other journals are now indispensable, but, notwithstanding the care exercised by the Sub-Editor, to whom the Society is greatly indebted, and the very moderate remuneration of the excellent body of Abstractors, the cost of their preparation is very heavy.

The amount which will appear in the next balance sheet under the heads of salaries and wages will be somewhat larger, inasmuch as the increase will represent that for an entire year instead of only half a year as on the present occasion. The total cost of the last two volumes of the General Index was £1740, whilst the expenditure on the volume which is in course of preparation has, up to the present, been £204. The greater part of the cost is therefore still to be met. On the other hand, the Library Catalogue is now completed, and for some years there need be no further expense in that form, although additional accommodation for the books will have to be provided immediately at an outlay which will probably approach £200.

The following tabular statement contains the chief items of income and expenditure during the past four years. The figures represent pounds, the shillings and pence being omitted. It will be seen that whilst the income of the Society is increasing the expenses are growing at nearly the same rate.

	1900.	1901.	1902.	1903.
Compositions	110	282	168	299
Admission Fees	468	464	652	520
Subscriptions	3510	3544	3712	3957
Sale of Journals	781	880	835	888
Dividends	444	464	476	506
Net Income	5371	5668	5844	6212
Assets	16710	17156	17807	18446
Expenses	4993	4932	4913	5384
Surplus	377	736	930	827

The Treasurer recalled with satisfaction the sale of Consols previously held by the Society in his first year of office. A serious loss was thus avoided, and, by the reinvestment of the proceeds, a slight addition was secured to the income of the Society.

The estimated values of the securities are all slightly less than at this time last year, but the further investment in May last in £1200 of Leeds Corporation Stock now brings the Assets of the Society to the respectable figure of £18,446 17*s.* 3*d.*

The TREASURER, in concluding, proposed a vote of thanks to the Auditors, which was acknowledged by Dr. L. T. THORNE.

Professor DEWAR proposed a vote of thanks to the Treasurer, Secretaries, and Council. The motion was seconded by Professor W. H. PERKIN, and unanimously adopted. Professor DUNSTAN responded.

The PRESIDENT then delivered his address, in which he called attention to the publication of some recent reports on progress in chemical research, and urged the publication of similar digests. He mentioned that this year would see the centenary of Dalton's statement of his atomic theory, which rose, as Nernst truly said, "by a single effort of modern science, like a phœnix from the ashes of the old Greek philosophy." He urged the study of "comparative chemistry" of inorganic compounds. There were few inquiries of greater interest than those involving inorganic isomerism, which was now either completely ignored or only slightly mentioned. Polymerism, or molecular condensation, was well known to exist in many inorganic compounds, as in the oxides of nitrogen, vanadium, niobium, and tantalum. Silicon showed a great analogy to carbon, and it was highly probable that some of the native silicates were benzenoid combinations of $6SiO_2$. The more familiar cases of isomerism were the nitrites and sulphites, and isomerism had also been observed in the thiosulphates and the salts of the phosphorous acids. Attention was directed to some cobalt, platinum, and molybdenum compounds which showed this peculiarity. Another analogy between carbon and inorganic compounds was the curious and interesting catalytic action, referred to by Bredig under the title of "inorganic ferments." Colloid platinum solutions acted on many substances in the same way and under similar laws as enzymes. The whole subject was little known, but it suggested that the broader study of inorganic chemistry, especially in the light of our knowledge of the "organic" division of the science, was well worthy of much greater attention than it had received of late.

Dr. RUSSELL, in moving the adoption of the report, proposed a vote of thanks to the President, coupled with a request that he would allow his address to be printed in the *Transactions*.

Professor THORPE seconded the motion, which was carried by acclamation.

After the President had returned thanks, the Scrutators presented their report to the President, when he declared the following to have been duly elected as Officers and Council for the ensuing session :—

President: W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: Wyndham R. Dunstan, M.A., F.R.S.; P. F. Frankland, LL.D., F.R.S.; David Howard; Herbert McLeod, F.R.S.; Raphael Meldola, F.R.S.; H. A. Miers, D.Sc., F.R.S.

Secretaries: A. Scott, M.A., D.Sc., F.R.S.; W. P. Wynne, D.Sc., F.R.S.

Foreign Secretary: Sir W. Ramsay, K.C.B., LL.D., F.R.S.

Treasurer: Horace T. Brown, LL.D., F.R.S.

Other Members of Council: J. J. Dobbie, M.A., D.Sc.; Augustus E. Dixon, M.D.; M. O. Forster, Ph.D., D.Sc.; A. Harden, D.Sc., Ph.D.; J. T. Hewitt, M.A., D.Sc.; C. A. Kohn, Ph.D., B.Sc.; J. E. Marsh, M.A.; E. J. Mills, D.Sc., LL.D., F.R.S.; S. U. Pickering, M.A., F.R.S.; S. Ruhemann, M.A., Ph.D.; J. A. Voelcker, Ph.D.; James Walker, D.Sc., F.R.S.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society took place at the Whitehall Rooms on Wednesday, March 25th, at 7 p.m., when the following Fellows and their guests dined together:—

Abney, Sir W., K.C.B., F.R.S.
Adie, Mr. R. H.
Alldred, Mr. C. H.

Baker, Mr. H. B., F.R.S.
Barlet, Mr. S.
Bauerman, Prof. H.
Beadle, Mr. C.
Bennett, Mr. J. H.
Bewsher, Mr. S.
Bowley, Mr. J. J.
Boys, Prof. C. V., F.R.S.
Brabrook, Mr. E. W., C.B.
Brough, Mr. B. H.
Brown, Mr. H.
Brown, Dr. H. T., F.R.S., *Treasurer-Elect.*

Carr, Mr. S. E., *Assistant Secretary.*
Chapman, Mr. A. C.
Chattaway, Dr. F. D.
Chaytor, Mr. A. H.
Clapp, Mr. R. R.
Connah, Mr. J.
Cooper, Mr. A.

Dickins, Mr. F. V., C.B.
Divers, Prof., F.R.S.

Dodds, Mr. J. M.
Dowson, Dr. W.
Dunstan, Prof. W. R., F.R.S., *Hon. Secretary and Vice-President-Elect.*
Dyer, Dr. B.

Eastick, Mr. C. E.
Epps, Mr. J., jun.

Fairley, Mr. T., *President of the Society of Public Analysts.*
Fenton, Mr. H. J. H., F.R.S.
Fletcher, Mr. L., F.R.S.
Forster, Dr. M. O.

Glazebrook, Dr. R. T., F.R.S. *President of the Physical Society.*
Gordon, Mr. J. G.
Goulding, Mr. E.
Gowland, Prof. W.
Greenaway, Mr. A. J., *Sub-Editor.*

Hall, Mr. E. B.
Hall, Mr. S.
Harden, Dr. A.
Hartley, Mr. H.
Hartley, Mr. H. B.
Harvey, Mr. E. W.
Harvey, Dr. J. S.
Henry, Dr. T. A.
Hewitt, Dr. J. T.
Hill, Mr. A. Croft.
Hill, Mr. C. A.
Hills, Mr. W.
Holloway, Mr. G. T.
Howard, Mr. D., *President of the Institute of Chemistry.*
Howie, Mr. W. L.

Jones, Mr. H. O.
Jowett, Dr. H. A. D.
Judd, Prof. J. W., C.B., F.R.S.

Kelvin, Lord, G.C.V.O., O. M., *President of the Royal Society of Edinburgh.*
Kempe, Mr. A. B., F.R.S., *Treasurer of the Royal Society.*
Knowles, Mr. J.

Larmor, Prof. J., *Secretary of the Royal Society.*
Le Rossignol, Mr. A. C.
Le Sueur, Dr. H. R.
Lewkowitsch, Dr. J.
Lock, Mr. C.
Louis, Mr. D. A.
Lowry, Dr. T. M.
Lunge, Prof. G., Ph.D.

McCormick, Rev. Canon, D.D.
MacEwan, Mr. P.
Mackenzie, Capt. N. F.
MacMahon, Major P. A., R.A., F.R.S.
Marr, Mr. J. E., F.R.S.
Marsh, Mr. J. E.
Martin, Mr. N. H.
Martineau, Mr. W.
Matthews, Dr. F. E.
Maxwell, Rt. Hon. Sir H., M.P., F.R.S.
Messel, Dr. R.
Miers, Prof. H. A., F.R.S.
Minssen, Mr. B.
Moody, Dr. G. T.
Morgan, Dr. G. T., *Editor.*
Morning Post.
Müller, Dr. H., F.R.S.
Murphy, Mr. A. J.

Newsholme, Mr. G. T. W., *President of the Pharmaceutical Society.*
Nicholson, Mr. F. G.

Orton, Dr. K. J. P.

Page, Mr. F. J. M.
Pam, Mr. A.
Perkin, Mr. A. G.
Perkin, Dr. W. H., F.R.S.
Perkin, Prof. W. H., F.R.S.
Philip, Dr.
Ping, Mr. W.
Pizey, Mr. J. H.
Power, Dr. F. B.
Press Association.
Pritchard, Prof. W.

Ramsay, Sir W., K.C.B., F.R.S., *Foreign Secretary.*
Rawson, Mr. C.
Reynolds, Prof. J. E., F.R.S., *President.*
Richardson, Mr. O. W.
Ruhemann, Dr. S.
Russell, Mr. J. B.
Russell, Mr. T. H.
Russell, Dr. W. J., F.R.S.

Schack-Sommer, Dr. G.
Scott, Dr. A., F.R.S., *Hon. Secretary.*
Smith, Mr. L.
Standard, The.
Steele, Mr. R., *Librarian.*
Stevenson, Dr. T.
Strouts, Mr. E. M.
Sullivan, Dr. Washington.
Swinburne, Mr. J., *President of the Institution of Electrical Engineers.*

Taylor, Mr. R. W. Cooke.
Thiselton-Dyer, Sir W. T., K.C.M G., F.R.S., *Director of the Royal Gardens, Kew.*
Thomson, Prof. J. M., F.R.S.
Thorpe, Prof. T. E., C.B., F.R.S., *Foreign Secretary of the Royal Society.*
Tidy, Mr. H. L.
Tilden, Prof. W. A., F.R.S., *Treasurer and President-Elect.*

Times, The.
Tyrer, Mr. T.
Voelcker, Dr. J. A.
Wade, Dr. J.
Wallis, Mr. T. E.
Webb, Mr. C. C. J.
Williamson, Mr. S.
Wynne, Prof. W. P., F.R.S., *Hon. Secretary-Elect.*

The following toasts were proposed:—

By THE PRESIDENT.

1. His Most Gracious Majesty the King.
2. Her Majesty the Queen Alexandra, their Royal Highnesses the Prince and Princess of Wales, and the other Members of the Royal Family.

By Professor T. E. THORPE, C.B., F.R.S.,
Foreign Secretary of the Royal Society.

3. The Houses of Legislature, coupled with the names of the Rt. Hon. LORD KELVIN, G.C.V.O., O.M., *President of the Royal Society of Edinburgh,* and the Rt. Hon. Sir HERBERT MAXWELL, Bart., M.P., F.R.S.

By Sir W. T. THISELTON-DYER, K.C.M.G., F.R.S.,
Director of the Royal Gardens, Kew.

4. Prosperity to the Chemical Society.

By Professor W. A. TILDEN, D.Sc., F.R.S.,
President-Elect of the Chemical Society.

5. The Guests, coupled with the names of Mr. A. B. KEMPE, *Treasurer of the Royal Society,* Mr. JAMES SWINBURNE, *President of the Institution of Electrical Engineers,* and Professor GEORGE LUNGE, *The Polytechnicum, Zurich.*

THE PRESIDENT, in proposing the loyal toasts, said that when the Fellows of the Chemical Society last dined together they were mourning the loss of their great and venerable Queen, and were engaged in a sanguinary war. To-day they were in happier circumstances; the war cloud had disappeared, and that other cloud of suffering through which the King had to pass after his Accession was now but a memory. They might therefore now rejoice and join with new meaning in the old cry of "Long live the King."

Professor THORPE, in proposing the toast of the Houses of Legislature, said that the theme offered many tempting possibilities. All would admit that both Houses showed an intelligent appreciation of the important part science plays in the conduct of human affairs nowadays, and in directing human development, even to the extent of preserving the national existence of the people for whom these Houses have to legislate.

Now, the House of Lords is singularly fortunate in that it possesses three at least of the most distinguished representatives, not only of British science, but of the science of the whole world—Lord Lister, Lord Rayleigh, and last, but not least, Lord Kelvin, whom we have the honour and pleasure of welcoming here to-night.

It was a circumstance unique in the history of any legislative assembly that there should be at one time three men of such world-wide prominence in the councils of any nation. In France such a thing does not happen; nor even in Germany, so often held up to us as an example of what should be in the relations of the State to science. The House of Commons is not so rich in scientific ornaments. It is true that she possesses in the person of the Secretary of the Royal Society, the Member for the University of London, a man who is a host in himself. As for Sir Herbert Maxwell, like Lord Kelvin, he is no stranger within our gates. His position as a literary man is well known to all. It does not seem to matter to him whether he is chronicling the achievements of some great master in the art of war or of some great master in the art of painting. On history, biography, fiction, natural history, his busy pen has left its mark. He is known in yet another sphere of action to several who are here to-night, and who have had the honour and pleasure of sitting under him on certain departmental committees in which, as a member of the Legislature, he has taken a leading part. Although all may not have seen the results of these inquiries from the same point of view, all are agreed in tendering to Sir Herbert Maxwell their appreciation of his urbanity, courtesy, impartiality, and knowledge of procedure.

In responding for the House of Lords, LORD KELVIN pointed out the blood-relationship which exists between the peerage and modern chemistry, for was not the Hon. Robert Boyle "the father of modern chemistry and brother of the Earl of Cork?" But without straining this relationship too far, there was much in modern science which linked it to the peerage. We have the Marquis of Worcester with his steam-engine, Baron Napier and his logarithms, the Hon. Robert Boyle, Cavendish who added so enormously to our knowledge of electricity and chemistry, and who obtained argon as a bubble the size of a pin's head by burning the nitrogen of the air with oxygen, Lord Rayleigh, who has made litres and litres of argon, Lord Salisbury, Lord Blythswood, and Lord Lister. But it was not only because the House of Lords contained many scientific men, but because, as Professor Thorpe had remarked, it was a working and a useful part of the Legislature of the British Empire, that he had to thank them for the toast. As for himself, he would like to say that all his life he had tried to be a chemist. Physical chemistry and chemical physics make up the whole of science outside of biology, at the present day. A great deal has been heard of physical chemistry. With some modification of its fundamentals, it had come to stay. We must now all be chemists, for chemistry is *the* science of the whole of matter. Gravitation has shown us great things at great distances. Cavendish pushed down the law of gravitation to small distances, but now we must go on down to infinitely smaller distances in connection with chemical affinity, which Cauchy supposed could act at distances infinitesimal with regard to the wave-length of light. The physicist must bow to the chemist to investigate these things. The largest part of physical science is chemistry, and the chemistry of the future is the whole of physical science.

SIR HERBERT MAXWELL, in replying for the House of Commons, said that in spite of all the kindliness infused into his allusions to the House of Commons, Professor Thorpe had given the impression that the atmosphere of the House of Lords was a purer and a loftier one. And so it is, but is that independent of the fact that so many of those who sit there have passed through the purgatory of the Lower House? Such are Lord Blythswood, Lord Avebury, better known as Sir John Lubbock, and many others. When the connection between science and the Legislature was mentioned, he feared lest the proposer of the toast was going to contrast what was done in this country for science with what was done in other countries. At the present time, for example, he was chairman of a departmental committee to inquire into the administration of the meteorological grant, which amounts to £15,000. In the United States the grant for a similar purpose is a quarter of a million. Although all the members of the committee appointed by the Privy Council to inquire into the working and amendment of the Pharmacy Acts did not put the same construction on the evidence brought before them, each was ready to give to every other full credit for the faithful discharge of duty according to his lights. Had the report depended on himself alone, he would have felt serious misgivings, especially after many letters he had received from members of a very important profession, but he was much indebted to the Chemical Society for the aid rendered to him by its ex-President, Professor Thorpe, its President-elect, Professor Tilden, and Dr. Stevenson. When it is considered how largely the use of poisonous substances has increased in agriculture, horticulture, and various other industries, he thought they were justified in coming to the conclusion that some relaxation of the restrictions imposed by the Pharmacy Act of 1868 had become urgent.

Sir W. T. Thiselton-Dyer said that it was with great pleasure that he proposed the toast of "Prosperity to the Chemical Society," especially as he had to couple with it the names of two great friends of his, those of the President, Professor Emerson Reynolds, and the Honorary Secretary, Professor Dunstan. To the former he owed much for introducing him many years ago to the society of the scientific men of the Irish capital, who were bound together by a *camaraderie* unknown in London. He understood that the President during the tenure of his office had travelled something like sixteen thousand miles in the performance of his duties. The Senior Secretary, whose scientific work he so highly appreciated, gives up his office after a decade spent in the service of the Society, and leaves work much more congenial to him to devote his energies to the task of co-ordinating the Imperial Institute into something useful to the Empire, in which he would have the hearty co-operation of Kew. There must be something in the science of chemistry which for its own sake can call forth such enthusiasm and energy. When the Society meets a century hence, he could conceive that they would look back on the chemistry of the present time much as the transcendental mathematician looks on the arithmetic of the Board school. The chemistry of to-day is probably only the expression of a particular view of material structure—a mere calculus which may be dispensed with. The dream of his old teacher, Sir Benjamin Brodie, may yet be realised, and we may not only be able to say what compounds are possible, but be able to predict their properties, their structure, their form. But what is to be said with regard to life? Lord Kelvin long ago suggested that it came from the stars. After some work with which Professor Dewar had kindly associated his name, he had no hesitation in saying that he could see no difficulty in protoplasm passing through stellar space even though it could not be reduced to chemical laws.

The President said he rose with very mingled feelings to respond. He did not know that he could claim that chemists as a body were particularly modest, but he thought that he might justly claim that the Society which was represented here to-night did admirable work and did it well. There was no harm in proclaiming that the Society was prosperous; its Fellows numbered 2471, and its income has reached the respectable sum of £6200, which has enabled it to print a very large amount of work contributed by its Fellows, many of whom, in addition it has been able to aid in a material way in the prosecution of their researches. They had always the certainty that truth acquired for its own sake would become of ultimate value to the human race. Now nothing contributes so much to the success of work in any department of human knowledge as a good working hypothesis. It is therefore interesting to note that they were in a measure celebrating the Centenary of the promulgation of the Atomic Theory. That great inspiration of Dalton's with regard to the discrete nature of matter seems to have been first made known in a tentative form to a select audience of nine persons. Now the whole world is the audience of the philosopher. It was invented to explain the chemical laws then known, and had exercised a most profound influence on the progress of science. It was the germ of that molecular theory of matter which pervades all chemistry and physics at the present time. Physicists seemed to expect them to think that all light and leading flows through them and many considered that Dalton's theory has had its day, but he agreed with Lord Kelvin that it had a long day yet.

PROFESSOR DUNSTAN expressed the great gratification it had been to him to be officially connected for the last ten years with the Society, which continues to grow from year to year, and reflects not only the progress of English chemistry, but of the science of chemistry throughout the world. One circumstance he would always recall with the greatest pleasure, and that was the harmonious way in which the officers had always worked together in promoting the best interests of the Society. All acknowledge how much chemistry owes to Germany, and here to-night is to be seen, for the first time by the Society, the bust of Liebig, to whom, both as a discoverer and as a teacher, our science is indebted so much. This gift, which will soon adorn the rooms of the Society, they owed to the generosity of Dr. Messel.

The PRESIDENT-ELECT, Professor TILDEN, said that the pleasant duty of proposing the health of their guests, had been assigned to him. Beside those whom they had had the pleasure of hearing, he might mention that they had with them the Director of the National Physical Laboratory, who was, also, most appropriately President of the Physical Society, the President of the Pharmaceutical Society, and the President of the Institute of Chemistry. He could assure the last named that although at one time it was feared that the Institute of Chemistry might interfere with the progress of the Chemical Society, he could assure its President that the Chemical Society looked with friendly eyes on its efforts to raise the qualifications of professional chemists, and to inculcate among its members those professional feelings with which every well-organised profession ought to be animated.

A secret which he had reserved for himself had been let out by Professor Dunstan. The bust of Liebig which they saw was said to be a faithful representation of the great master to whom the science of chemistry owed so much, and who was well-known in England forty-five years ago. Has he come back, like the statue of the commander in *Don Juan*, to remind us of our misdoings? For in 1837 Liebig wrote that he had been staying for a long time in England and had not learned much. He thought that could an opinion be obtained from him now it would be very different, for since that time vast revolutions had taken place. In this country we are always a little late in starting, but when we do start we do our work thoroughly; and he thought that the activity, energy, enthusiasm, and quality of the work done by the Society was not surpassed by any other society on the face of the globe. He had been instructed to couple with this toast the names of Mr. Kempe, Treasurer of the Royal Society, and that of his old friend and pupil, Mr. Swinburne, President of the Institution of Electrical Engineers. He might say that with regard to the Royal Society the Chemical Society looks towards it much as a daughter looks towards her mother even after she has left the parental roof. The acquisition of the three magic letters F.R.S. is still the ambition of all the young chemists of England, an ambition which has a very healthy influence as an incentive to the pursuit of scientific work. He hoped it would always be reserved as a prize for the successful worker, and awarded solely for additions to knowledge. Circumstances tempted him to ask them to join with this toast yet another well-known name, that of one of the Fellows of the Society, whose appearances are so rare that he comes almost with the prestige of a Foreign Member. All used to look upon Professor Lunge as an Englishman, but whatever he is now he trusted that he retained some kindly thoughts of by-gone days spent in England.

There were two reasons, Mr. KEMPE thought, why he had been asked to respond to this toast—one because he was the senior officer of the Royal Society present, and the other because he represented the law; but he was not on that account going to give them a speech of double length. To-night they had been brought together by the forces of chemical affinity, but soon the forces of dissociation must come into play; still, he ventured to hope that soon again the processes of synthesis would be re-established.

Mr. SWINBURNE said that it was very pleasant to have his old master, Professor Tilden, propose his name as one of their guests to-night. If, as a boy, he had ever any chemical microbes in him, it was by Professor Tilden that they had been fostered. Although all knew how unsafe it was to differ from Lord Kelvin on any point, he was going to claim chemical science as a small branch of that domain of science which he had the honour to represent, because the *Encyclopædia Britannica* says, and therefore it must be so, that all chemical action is but electrolysis. The foundations of chemistry have, on the whole, been more secure than those of most other sciences during these troublous times. Chemists did not suffer so much as electricians did, for they used to have one fluid, then two fluids, and now no fluid. They had to master a new theory almost every week or two. If there was one piece of advice he might be allowed to give, it would be to stick fast to their atoms and molecules.

PROFESSOR LUNGE said that he had been greeted by the President-elect as a guest, and in one sense he was so. He had the honour of being elected a Fellow of the Society thirty-five years ago, but had never been able until that day to be present at a single meeting. When he was elected he resided in the far north, and his visits to London were few and far between, and now that he was in Zurich they were naturally still more rare, yet he never came to London without looking to see whether he could not attend a meeting of the Society. Now to-day he had been able to attend the Annual General Meeting, and had hoped to be formally admitted a Fellow. He found, however, that that was against the Bye-laws, for it was only at Ordinary Scientific Meetings that Fellows could be admitted. He was therefore just where he was before, and so far entitled to be considered as a guest. Since the freedom of Zurich had been conferred upon him he had become a citizen of Switzerland, but he always felt himself to be what Professor Tilden called him—an English chemist. Whatever he had done he owed to his twelve years of English training, so he owed a debt of gratitude to this country, and he was glad to have this opportunity of saying so and of thanking them for the kind way in which he had been received.

Thursday, April 2nd, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. T. E. Wallis, R. C. Farmer, and H. W. Bywaters were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

William Godsell Burghard, 180, High Holborn, W.C.
Edwin Jesse Fairhall, 29, Winsham Grove, S.W.
Norbert Van Laer, 69, Calais Road, Burton-on-Trent.
Henry Wolff Levy, Chancery Lane, Melbourne.
Alfred Ernest Moore, B.A., B.Sc., St. John's College, Battersea, S.W.

George M. Norman, B.Sc., 5, Watford Villas, Battersea Park, S.W.
George Harry Parry, The Level, Brierley Hill, Staffordshire.
James C. Smith, B.Sc., 57, Great Ormond Street, W.C.

Of the following papers, those marked * were read:

*51. "The dioximes of camphorquinone, and other derivatives of *iso*nitrosocamphor." By M. O. Forster.

The dioximes of camphorquinone, three of which were described by Manasse (*Ber.*, 1893, 26, 243), have been obtained in purer condition, and the series of four completed. The following table summarises the chief characteristics of these substances:

	M. p.	$[\alpha]_D$ in alcohol.	$[\alpha]_D$ in 2 per cent. sodium hydroxide.	Precipitate with sodium hydroxide and ferrous sulphate.	C.c. of absolute alcohol at 20° required to dissolve 1 gram.
α-Dioxime ...	201°	−63·6°	−98·3°	Chocolate	40
β-Dioxime ...	248	—	−24·1	Chocolate	590
γ-Dioxime ...	135	+22·4	+12·6	None	1·0
δ-Dioxime ...	199	+75·5	+83·6	Chocolate	12·4

The *peroxide* of the dioximes, $C_{10}H_{14}O_2N_2$, obtained by oxidising them with potassium hypobromite, melts at 144·5°, and when reduced with zinc and acetic acid, yields the α-dioxime.

The *anhydride* of *iso*nitrosocamphor, $C_{20}H_{28}O_3N_2$, prepared by heating together the potassium and benzoyl derivatives of *iso*nitrosocamphor in benzene, is also formed when benzoyl chloride, acetyl chloride, phosphorus oxychloride, or acetic anhydride acts on the dry alkali derivatives. It melts at 187°, becoming transformed into the anhydride of α-camphornitrilic acid; a 2 per cent. solution in chloroform has $[\alpha]_D$ +141·7°.

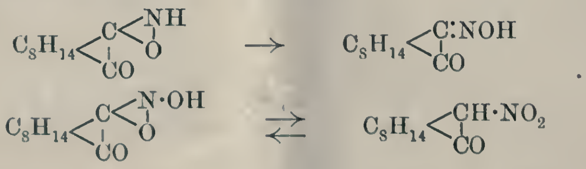
Two isomeric *compounds*, $C_{17}H_{18}O_5N_2$, melting at 136—137° and 152° respectively, are produced by the action of *m*-nitrobenzoyl chloride on an alkaline solution of *iso*nitrosocamphor. As in the case of the benzoyl derivatives, the substance of lower melting point is yellow, whilst the other is colourless. On hydrolysis, the former gives rise to a new modification of iso*nitrosocamphor*, $C_{10}H_{15}O_2N$; this compound, which is still under investigation, melts at 114° and passes into the known isomeride between that temperature and 152°.

DISCUSSION.

Dr. ARMSTRONG pointed out that if Dr. Forster's discovery of a yellow benzoyl*iso*nitrosocamphor were taken into account, together with Miss Whiteley's recent important observations on the colour of oximic compounds, the absence of colour from *iso*nitrosocamphor and the dioximes could only be explained—if they were regarded as true oximic compounds—on the assumption that they were polymerised molecules; but he was of opinion that it was premature, at present, to accept the explanation afforded by the Hantzsch-Werner hypothesis of the isomerism subsisting among the dioximes. On various grounds, he held this hypothesis to be open to grave question. Even the structure of camphorquinone appeared to be by no means placed beyond doubt.

Dr. SILBERRAD asked whether the benzoylation of camphor*iso*imide had been tried in perfectly dry pyridine in place of the alkaline solution used in the Schotten-Baumann reaction, and stated that this modification had proved very useful in the benzoylation of compounds which undergo immediate hydrolysis in contact with water.

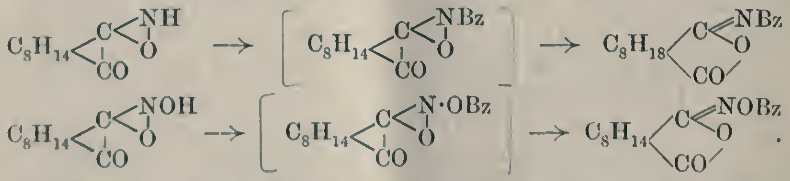
Dr. LOWRY said that if the labile form of *iso*nitrosocamphor were regarded as an *iso*oxime, the isomerism described by Dr. Forster would correspond closely with that of the *normal* and *pseudo*-nitrocamphors, as is shown by the formulæ:



$$C_8H_{14}<\begin{matrix}C<\begin{matrix}NH\\ |\\ O\end{matrix}\\ |\\ CO\end{matrix} \longrightarrow C_8H_{14}<\begin{matrix}C{:}NOH\\ |\\ CO\end{matrix}\;.$$

$$C_8H_{14}<\begin{matrix}C<\begin{matrix}N{\cdot}OH\\ |\\ O\end{matrix}\\ |\\ CO\end{matrix} \rightleftarrows C_8H_{14}<\begin{matrix}CH{\cdot}NO_2\\ |\\ CO\end{matrix}$$

The formation of a colourless benzoate might then be regarded as being due, in each case, to the benzoylation of the labile form with an accompanying isomeric change of the Beckmann type:



Dr. FORSTER stated that the molecular weight of the new *iso*nitrosocamphor had not been determined, but that as soon as the necessary material had been accumulated the general behaviour of the substance would be more closely studied; Dr. Silberrad's suggestion relating to camphor*iso*imide would be adopted.

*52. "Reversibility of enzyme or ferment-action."

By A. C. Hill

It has been shown previously that the hydrolysis of maltose to glucose by yeast extract in concentrated solution is incomplete, the phenomena being due to polymerisation of the glucose by a reversible process, and a point of equilibrium is approached which varies with the concentration of the total sugar. In further publications, it was also pointed out that the polymerisation of glucose resulted in the formation of isomeric sugars, and somewhat different results were obtained when Taka-diastase and the pancreatic ferments respectively were used instead of yeast extract. In every case, it was possible, by diluting solutions of the synthetical products, to hydrolyse these compounds back to glucose by the enzyme used in their synthesis. Further, it had been found that the synthetical products of the action with yeast extract are hydrolysed by Taka-diastase, and those of the action with Taka-diastase by yeast extract.

When the products of the synthetical change obtained by the use of yeast ferment, whilst still mixed with unchanged glucose, are fermented with *S. Marxianus*, only this hexose is fermented; but when a yeast containing maltase is employed, a part also of the synthetical product is fermented. Again, if the synthetical products in dilute solution are submitted to the hydrolytic action of yeast extract and then treated with *S. Marxianus*, the whole is fermented. The sugar that is not fermented either by *S. Marxianus* or by yeasts containing maltase has been separated and proves to be a new biose, which is called *revertose*. The other sugar, which is fermented by all yeasts containing maltase but not by *S. Marxianus*, is believed to be maltose, for although it has not been obtained pure, yet on fractionating mixtures of this sugar with revertose, specimens have been obtained in which the former sugar preponderates and of which the optical and other properties approach those of maltose. Its osazone crystallises in plates, whilst the corresponding derivative of revertose separates in needles. Revertose is formed in larger quantity, and the equilibrium point of glucose $\rightleftarrows$ revertose is more favourable to the synthetical change than the equilibrium point of maltose $\rightleftarrows$ glucose, which favours the hydrolytic reaction.

The products of the synthetical change with Taka-diastase are equally fermentable in part by all maltase-containing yeasts and, as previously indicated (*Proc.*, 1901, **17**, 184) are readily rehydrolysed by the same ferments in dilute solution. These products have not been separated.

Since the first paper on this subject (*Trans.*, 1898, **73**, 634), further observations of a similar nature have been made by the author and others, and the number of ferments for which a reversible action has been noted has become extended. These results warrant the adoption of the hypothesis that all ferment actions are reversible.

DISCUSSION.

Mr. A. R. **LING** said that recent experiments on the action of various hydrolytic enzymes on polysaccharides had shown that hydrolysis was invariably accompanied by a reversed or synthetical action, Dr. Hill being the first to notice that this reversion occurred when a concentrated solution of *d*-glucose is submitted to the action of yeast-maltase.

In conjunction with Mr. B. F. Davis, he had obtained evidence that a certain amount of reversion occurred at a certain stage in the reaction between malt diastase and 3 per cent. starch paste.

The use of the term "reversion" was, however, scarcely justifiable, as in no case had reversion led to the regeneration of the original carbohydrate, the products being *iso*-sugars, as had been shown in certain instances by E. Fischer and E. F. Armstrong. As it was extremely unlikely that the same product was obtained from a given carbohydrate by the use of different enzymes, the name "revertose" seemed too general for any specific compound obtained in this way.

Dr. E. F. **ARMSTRONG** remarked that the important question to be decided with reference to the synthetical action of enzymes was whether the sugar synthesised was identical or not with that normally hydrolysed by the enzyme, and expressed the view that, at present, the experimental evidence tends to prove that the synthesised biose and the hydrolysed biose bear the same relation to one another as do the α- and β-methyl glucosides. He thought that the portion of the material fermented by yeast was more likely glucose than maltose, and did not consider the evidence sufficient to establish the individuality of revertose as distinct from the *iso*maltose proved by Emmerling to be formed by the action of maltase on glucose.

Mr. J. L. **BAKER** inquired whether any derivatives of revertose other than the phenylosazone had been prepared as, for example, the acetyl and benzoyl compounds. Was the evidence of the identity of revertose based solely on the physical constants and the osazone?

In reply, Dr. **CROFT HILL** stated that revertose was obtained in white, crystalline, very hygroscopic crusts by dehydrating the vitreous mass in which it first separates from its alcoholic solution. It still contained a little ash, but the osazone was obtained quite pure.

Revertosazone is readily distinguished from Fischer's *iso*maltosazone by the fact that it is optically inactive, whereas Fischer's *iso*maltosazone was dextrorotatory.

The fermentation experiments with maltase-containing yeasts on the one hand, and with *S. Marxianus* on the other were conducted on parallel lines, analyses being made at every step. The difference in the two cases could only be explained by the fact that in the former case a part of the synthetical product was fermented.

The view put forward by one school of chemists in Germany, that the action of ferments was not truly reversible, but that the substance synthesised is always different from the substance hydrolysed, is untenable, for in every case the synthesised substance can again be hydrolysed by the ferment which produces it.

He considered it likely that conditions of equilibrium may favour such a practical outcome, and the synthetical process in the organism may have such a relationship to the analytical process, but, theoretically, each component of the process is reversible in the strictest chemical sense.

*53 "Discoloured rain." By E. G. Clayton.

The rain which fell for some hours on Sunday, February 22nd, 1903, in all counties south of the Thames, and elsewhere, as at Clare in Suffolk, Oswestry in Salop, and on the Continent, as at Bochum in Westphalia, was turbid and discoloured, soiled window glass to an unusual extent, and left, on exposed surfaces, a greyish-brown or terra-cotta-coloured deposit. The wind prevailing at the time was very high, and generally westerly or south-westerly. It has been suggested that the deposit was of volcanic origin, and probably due to the West Indian eruptions.

The following results were obtained with a specimen of the rain collected by Mr. R. Pound at Ashbury, near Shrivenham, Berkshire.

Chemical Examination.—After five days, the water remained opalescent and yielded an extremely fine, light brownish-red sediment:

		Parts in 100,000.		Parts in 1,000,000.
(*a*)	Dissolved solids (dried at 150°) ...	25·1	Ammonia (free and saline)	0·95
	Dissolved solids (after ignition) ...	21·1	Ammonia (on boiling with alkaline permanganate)	0·15
(*b*)	Suspended matter ...	23·6		
	Chlorine	2·0		

The residue (*a*), after evaporation, blackened on ignition with an odour of burning wood, and, on further heating, the carbon soon disappeared. The inorganic matter was mainly calcium carbonate; alkaline chlorides and iron compounds being also present.

The suspended matter, which contained a mere trace of carbonate, was almost insoluble in dilute acids, but decomposed on warming with moderately concentrated sulphuric acid; its chief components were silica (67·5 per cent.), alumina and ferric oxide (14·1 per cent.), and volatile matter (12·4 per cent.). The separated silica was perfectly white, and the volatile matter principally of organic origin.

The great differences between this specimen and ordinary rain water, especially as regards the proportions of chlorine, dissolved solids, and suspended substance, are sufficiently obvious.

Biological Examination.—One c.c. of the water, by plate-cultivation on nutrient gelatin at 20—22°, yielded, by the fourth day, 420 bacterial colonies. Of these, 19 were non-liquefying, iridescent expansions of irregular outline, having the characters of *Bacillus fluorescens non-liquefaciens*; the rest, which were sharply-outlined, circular, pearly dots, resembled *Bacillus liquefaciens*, and began to liquefy the gelatin on the third day. After incubation for 24 hours at 38°, 1 c.c. of the water showed, in 5 days, only 33 bacterial colonies (*Bacillus subtilis* ?).

Microscopical Examination of the Sediment.—The particles, which ranged in size from 0·001 to 0·005 mm., were yellow or brown, resembling those of clay. This similarity was noticed by Professor Bonney in a recently published letter describing some specimens of the deposit which he had received. In the sediment now under discussion, there were no vitreous, and very few angular, particles: between crossed Nicols prisms, the field was faintly illuminated. No pollen granules could be distinguished (although these appear to have been observed at Denchworth, Berkshire). The analysis, however, clearly indicates that some organic matter was present, both in solution and also in suspension in an exceedingly fine state of division.

The results show that this rain was charged with wind-borne dust, which in the specimen examined was a marly and ferruginous clay, mixed with organic refuse, perhaps of animal, as well as vegetable, origin; the calcareous matter had mainly dissolved in the water, which contained carbon dioxide, whilst the argillaceous and siliceous portions were carried in suspension. This composition is just such as might be expected in dust blown from the Jurassic and Cretaceous drift of Wessex roads and lanes. It is, therefore, not necessary to assume that the dust was conveyed either from remote regions or across the sea, and there are good grounds for supposing that, if a series of analyses had been made of the rain and sediment from different places, the figures would have reflected in some degree the local characteristics of the soils and subsoils of areas situated at a distance of a few miles, or even less, immediately to the west or south-west of those places. In a marly district, the ratio of calcareous matter to clay and silica would be high; where loam prevailed, fine siliceous sand would predominate; further west, felspar crystals and ferro-magnesian minerals would abound, possibly with less organic matter; from highly cultivated tracts, pollen granules might arise, and so on. Ashbury is situated partly on the Upper Greensand and partly on the chalk, and in the vicinity there are extensive areas of clay and chalk. An analysis by Mr. R. A. Earp (*Nature*, 1903, 67, 414) of matter deposited by the rain, which fell on the same day at Buckfastleigh, Devon, showed that the sediment there contained less silica and more organic matter than the deposit examined by the author.

Discussion.

Dr. H. R. Mill said that he was investigating the fall of dust on February 22nd from a meteorological point of view in conjunction with Mr. Lempfert of the Meteorological Office, and Mr. Clayton's theory of the local origin of the dust would be tested before long by the examination of fifty specimens obtained from rainfall observers and others in many parts of England and Wales and some places abroad, this work having been undertaken by the Geological Survey. The magnitude of the dust-fall made it difficult to accept this hypothesis without very strong proof. In the south of England and in Wales, the dust, which was remarkably uniform in appearance, had fallen either dry or in rain over a space of 300 miles from west to east and 200 miles from south to north, whilst traces had occurred at intervals over the whole area of the British Isles from Scilly to Shetland. The fact that similar dust was observed on the same day over the greater part of the Channel Isles, Belgium, and Holland, and at many places in Germany, Switzerland, and Austria, as well as in the North Atlantic, whilst dust-storms prevailed off the coast of Africa, made a common origin seem very probable, and perhaps this was a case of far-travelled, wind-borne dust.

54. "The absorption spectra of nitric acid in various states of concentration." By W. N. Hartley.

Photographs have been obtained of the spectra of nitric acid in eight different states of concentration, varying from 89·6 per cent. of HNO_3 (sp. gr. 1·490 at 15°) to 20·31 per cent. (sp. gr. 1·127 at 15°).

Acid of sp. gr. 1·490 transmits a very short spectrum, which is greatly lengthened by dilution. The acid of sp. gr. 1·432 (72·57 per cent.) transmits a longer spectrum than the 20·31 per cent. solution, but this is shortened on dilution; in like manner, weaker acids down to that of sp. gr. 1·127 behave in the same way, but here the dilute solution transmits a spectrum nearly as long as the strong acid. From this point onwards, an absorption band makes its appearance. If water acted simply as a diluent, dilution would cause an increase in the length of the transmitted spectra which would be proportional to the quantity of water added. There is evidently some chemical action between the water and the acid, but this action with acid of sp. gr. 1·490 is different from that with acid of sp. gr. 1·432 or any less concentrated acid. Hence it is probable that in strong nitric acid, the molecule is either polymerised to $n(HNO_3)$ or resolved into a compound of the nature of N_2O_5,H_2O. The acid of sp. gr. 1·490 might be represented either as a mixture, $N_2O_5,H_2O + H_3NO_4$, or as a compound, $H_3N_3O_9,H_2O$. The weaker solutions of the acid probably contain hydrates. Evidence is afforded that the strong acid contains two different substances, one of which acts on caustic lime whilst the other does not.

55. "Salts of an isomeric mercaptoid form of thioallophanic acid, and a new synthesis of alkyl iminothiocarbamates." By A. E. Dixon.

By heating ethyl chlorocarbonate with phenylthiourea on the water-bath in presence of benzene, carbon dioxide was expelled and a yellow syrup formed, the latter being the hydrochloride of Bertram's (*Ber.*, 1892, **25**, 55) ethyl iminophenylthiocarbamate, $NPh\colon C(NH_2)\cdot SEt$ or $NHPh\cdot C(NH)\cdot SEt$: – $NHPh\cdot C(NH)\cdot SH + EtO\cdot COCl = CO_2 + NHPh\cdot C(NH)\cdot SEt,HCl$. With methyl chlorocarbonate, under like conditions, the hydrochloride of methyl iminophenylthiocarbamate was obtained.

p-Tolylthiourea and methyl chlorocarbonate yielded the *hydrochloride* of *methyl imino*-p-*tolylthiocarbamate*, $NH(C_7H_7)\cdot C(NH)\cdot SMe,HCl$, in long, white prisms melting at 154—155°; the corresponding *base* could only be obtained as an oil. From *o*-tolylthiourea, by heating with methyl chlorocarbonate, a syrupy hydrochloride was produced; the corresponding free base, liberated by the cautious addition of alkali, crystallised from light petroleum in white lozenges melting at 101—102°.

Methyl iminoallylthiocarbamate, $NH(C_3H_5)\cdot C(NH)\cdot SMe$, was not precipitated by alkali from the aqueous solution of its hydrochloride; the *picrate* formed yellow, hair-like needles melting at 149—150° (corr.).

Thiocarbanilide, when heated with ethyl chlorocarbonate, affords a carbethoxy-derivative melting at 95°, which is non-basic and appears to have the constitution $NHPh\cdot CS\cdot NPh\cdot CO_2Et$ (Seidel, *J. pr. Chem.*, 1885, **32**, 262); the *methyl* homologue crystallises from alcohol in white needles melting at 105°.

Experiments conducted in the cold led to results entirely different from those just mentioned; thus, methyl chlorocarbonate, when allowed to remain in contact with finely-powdered, monosubstituted thioureas, gradually reacted, without evolution of gas, to form additive products; these substances, which dissolved freely in water, yielding very acid solutions, proved to be hydrochlorides. By neutralising with alkali, or even by prolonged boiling of their aqueous solutions, the acid could be readily withdrawn, thereby leaving crystalline solids, sparingly soluble in water and melting, with decomposition, at relatively high temperatures.

The following compounds of this class are described:

Methyl phenylthio-ψ-allophanate, $NHPh{\cdot}C(NH){\cdot}S{\cdot}CO_2Me$, brilliant prisms, m. p. 166—167° (corr.); *methyl* p-*tolylthio-ψ-allophanate*, $NH(C_7H_7){\cdot}C(NH){\cdot}S{\cdot}CO_2Me$, flattened, white prisms, m. p. 175—176° (corr.); *methyl* o-*tolylthio-ψ-allophanate*, colourless prisms, m. p. 175—176° (corr.).

Thiourea itself also affords, with chlorocarbonates, two distinct classes of derivatives.

Ethyl thio-ψ-allophanate, $NH_2{\cdot}C(NH){\cdot}S{\cdot}CO_2Et$, is formed when thiourea and ethyl chlorocarbonate are very cautiously warmed in presence of benzene or, preferably, absolute alcohol, or by adding carbonyl chloride, in toluene, to thiourea suspended in absolute alcohol; its hydrochloride forms beautiful, transparent octahedra melting at 116—117° with effervescence, due to the escape of carbon dioxide; the fusion product, a viscid syrup which appears to be identical with that obtained by heating thiourea with the chlorocarbonate, is the *hydrochloride* of *ethyl iminothiocarbamate*, $NH_2{\cdot}C(NH){\cdot}SEt$.

Methyl thio-ψ-allophanate, like the ethyl homologue, is readily soluble in water; its hydrochloride forms a white, crystalline powder, which melts at 89—90° with effervescence and is thus converted into *methyl iminothiocarbamate hydrochloride*, $NH_2{\cdot}C(NH){\cdot}SMe,HCl$; this product, when obtained by heating thiourea and methyl chlorocarbonate in presence of benzene, separates as an oil, which subsequently changes to a crystalline solid melting at 59—60°. Both this and the corresponding ethyl derivative give mercaptan with cold alkali hydroxides, and yellow precipitates with alkaline lead and silver salts; the thio-ψ-allophanic compounds, on the other hand, yield no mercaptan with alkali, and are simply desulphurised by treatment with the metallic salts.

56. "Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone." By F. D. Chattaway.

Considerable quantities of *o*-aminobenzophenone and *p*-aminobenzophenone having been prepared in an investigation of the transformation of dibenzanilide into these substances (this vol., 57), a number of their nitrogen halogen derivatives have been studied. These are formed by the action of aqueous hypochlorous or hypobromous acid on the acylaminobenzophenones dissolved in alcohol, but in order to obtain products that can be crystallised it is necessary to work at a low temperature and to guard carefully against any liberation of free halogen. The nitrogen halogen derivative can be extracted with chloroform and recrystallised from light petroleum or a mixture of this and the preceding solvent.

Acetyl-o-*chloroaminobenzophenone,* $Ph\cdot CO\cdot C_6H_4\cdot NClAc$, colourless, flattened prisms with domed ends, m. p. 102°; *acetyl*-o-*bromoaminobenzophenone,* $Ph\cdot CO\cdot C_6H_4\cdot NBrAc$, short, transparent, yellow prisms, m. p. 121°; *propionyl*-o-*chloroaminobenzophenone,* $Ph\cdot CO\cdot C_6H_4\cdot NCl\cdot COEt$, clusters of colourless, flattened prisms, m. p. 107°; *propionyl*-o-*bromoaminobenzophenone,* clusters of yellow plates, m. p. 90°; *benzoyl*-o-*chloroaminobenzophenone,* $Ph\cdot CO\cdot C_6H_4\cdot NCl\cdot COPh$, colourless, rhombic plates, m. p. 98°.

Acetyl-p-*chloroaminobenzophenone,* groups of colourless, slender, flattened plates, m. p. 124°; *acetyl*-p-*bromoaminobenzophenone,* groups of pale yellow, six-sided plates, m. p. 151°; *propionyl*-p-*aminobenzophenone,* colourless, elongated plates, m. p. 139°; *propionyl*-p-*chloroaminobenzophenone,* colourless, flattened prisms, m.p. 129°; *propionyl*-p-*bromoaminobenzophenone,* $Ph\cdot CO\cdot C_6H_4\cdot NBr\cdot COEt$, pale yellow plates, m. p. 123°; *benzoyl*-p-*chloroaminobenzophenone,* clusters of colourless plates, m. p. 107°; *benzoyl*-p-*bromoaminobenzophenone,* clusters of yellow, rhombic plates, m. p. 93°.

The transformation which occurs when these substituted nitrogen chlorides and bromides are heated above their melting points is accompanied by considerable decomposition, and dark, impure products are obtained. When the compounds are dissolved in acetic acid and warmed, the halogen passes from the nitrogen into the ring in the usual manner.

57. "Action of caustic alkalis on cinnamic acid dibromide and its esters." By J. J. Sudborough and K. J. Thompson.

Good yields of α-bromocinnamic and α-bromo*allo*cinnamic acids may be obtained under suitable conditions by the action of caustic alkalis on cinnamic acid dibromide and its esters. The relative amounts of the two acids produced depend mainly on the employment either of the acid dibromide or of an ester, and, to a less extent, on the alkali and the solvent; the yield of α-bromo-acid (m. p. 131°) is always greater when an ester is employed. In no case has it been found possible to obtain only the normal product, namely, α-bromo*allo*cinnamic acid. The two acids are readily separated by the aid of their barium salts.

A bye-product often obtained is ω-bromocinnamene, $CHPh{:}CHBr$, and this appears to be a primary decomposition product of the acid dibromide, and is therefore not obtained indirectly from one or the other of the α-bromo-acids, as stated by Barish. The addition of bromine to ethyl cinnamate and the transformation of the *allo*-acid into the α-bromo-acid have also been studied.

58. "The composition of Caro's acid." By T. S. Price.

Armstrong and Lowry (*Proc. Roy. Soc.*, 1902, **70**, 94) have shown that, in dilute solution, Caro's acid is to be represented either by the formula $H_2S_2O_4$, assuming that the acid is dibasic, or by H_2SO_5 if the compound is regarded as monobasic. Since this conclusion is opposed to the results formerly obtained by the author (*Ber.*, 1902, **35**, 292), a new series of experiments on the increase of acidity has been undertaken, and the revised data now agree with the results of these investigators, although the method employed in the author's experiments was less accurate.

The increase in acidity was formerly estimated by means of barium hydroxide solution, but Caro's acid, when neutralised by this alkali, is decomposed, 1 mol. of $H_2S_2O_9$ giving rise to 2 mols. of H_2SO_4, so that the actual increase is twice the calculated quantity. If sodium hydroxide is employed, the acid is not decomposed, and the normal increase in acidity is indicated.

This difference in the behaviour of the two alkalis is also suggested by a determination of the ratio of iodine equivalent to increase in acidity, the mean values found being 4·74 and 2·75 for sodium hydroxide and barium hydroxide respectively. The deviation from the corresponding theoretical numbers (5·18 and 2·59) is probably due to experimental errors.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Mulder, Genardus Joannes. Bijdragen tot de geschiedenis van het scheikundig gebonden water (being *Derde stuk, derde deel* of *Scheikundige verhandelingen en onderzoekingen*). Rotterdam 1864. From Prof. Tilden, F.R.S.

Holleman, Arnold Frederick. A text-book of inorganic chemistry, rendered into English with the cooperation of the author by Hermon C. Cooper. ill. New York and London 1902. From the Publishers.

Armsby, Henry Prentiss. The principles of animal nutrition with special reference to the nutrition of farm animals. New York and London 1903. From the Publishers.

Chemical Technology or Chemistry in its applications to arts and manufactures, with which is incorporated Richardson and Watts' Chemical Technology. Edited by Charles Edward Groves and William Thorp. Vol. III. Gas lighting, by Charles Hunt. ill. London 1900. From the Publishers.

Chemical Technology or Chemistry in its applications to arts and manufactures, with which is incorporated Richardson and Watts' Chemical Technology. Vol. IV. Edited by William Joseph Dibdin. Electric lighting, by A. G. Cooke, Photometry by William Joseph Dibdin. ill. London 1903. From the Publishers.

Sprengel, Hermann. The discovery of picric acid (Melinite, Lyddite) "as a powerful explosive" and of cumulative detonation with its bearing on wet guncotton. Second edition. London 1903. From the Author.

Hoff, Henricus Jacobus van't. Vorlesungen über theoretische und physikalische chemie. Zweites Heft. Die chemische Statik. 2nd ed. ill. Braunschweig 1903. From the Author.

II. *By Purchase.*

Buchner, Eduard, Buchner, Hans, and Hahn, Martin. Die Zymasegärung, Untersuchungen über den Inhalt der Hefezellen und die biologische Seite des Gärungsproblems. München 1903.

Lassar-Cohn, ——. Arbeitsmethoden für organisch-chemische Laboratorien, ein Handbuch für Chemiker, Mediziner, und Pharmazeuten. 3rd ed. Hamburg 1902.

Vogl, August Emil. Die wichtigsten vegetabilischen Nahrungs- und Genuss-mittel, mit besonderer Berücksichtigung der mikroskopischen Untersuchung auf ihre Echtheit, ihre Verunreinigungen und Verfalschungen. ill. Berlin 1899.

Frühling, Robert. Anleitung zur Untersuchung der für die Zuckerindustrie in betracht kommenden Rohmaterialien, Produkte, Nebenprodukte, und Hilfssubstanzen. 6th edition. ill. pp. xxi—505. Braunschweig 1903.

Lindner, Paul. Atlas der mikroskopischen Grundlagen der Gärungskunde mit besonderer Berücksichtigung der biologischen Betriebskontrolle. 111 Tafeln mit 418 Einzelbildern. Berlin 1903.

Borchers, Wilhelm. Das neue Institut fur Metallhüttenwesen und Elektrometallurgie an der königlichen technischen Hochschule zu Aachen (Abschnitt. Elektrische Messinstrumente). Halle 1903.

Borchers, Wilhelm. Elektro-Metallurgie des Nickels. ill. (*being* part of Bd. VI. Monographien über angewandte Elektrochemie. Halle 1903.

Roesler, Leonhard. Mittheilungen über die Arbeiten der K.K. chemisch-physiologischen Versuchs-station für Wein- und Ostbau zu Klosterneuburg bei Wien bis Ende Juli 1902. Heft. VI. ill. Wien u. Leipzig 1902.

Glasgow. Corporation Water Works. Reports on the supply of water to the city. 1853—1855.

At the next ordinary meeting, on **Wednesday**, April 22nd, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution." By F. G. Donnan and R. de Rossignol.

"A microscopic method of determining molecular weights." By G. Barger.

"Note on the spectrum of pilocarpine nitrate." By W. N. Hartley.

"Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone." By F. D. Chattaway.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, April 22nd, 1903.

Adshead, Henry Guest,

Heysham, Wimbledon Park, Wimbledon.

Analytical Chemist. Analytical Chemist and Assayer. Four years assistant to Mr. Leo Taylor, F.I.C., Public Analyst. Four years chief assistant to Mr. J. P. Norman, F.C.S. Gas Examiner under the London County Council.

John P. Norman.	*J. H. Coste.*
Charles Watson.	*Otto Hehner.*
Frank Clowes.	*H. Royal Dawson.*
R. Grimwood.	*Arthur J. Starey.*

Alton, William Lester St. John,

Dungarvan, Putney Heath, S.W.

Chemical Student. Associate of the Institute of Chemistry. Student at University College, Gower Street, W.C. I desire the publications of the Society.

William Ramsay.	Edward C. Cyril Baly.
J. Norman Collie.	Morris W. Travers.

F. G. Donnan.

Atkinson, Harford Montgomery,

32, Bagnall Road, Milton, Staffordshire.

Chemist to the British Aluminium Co., Ltd. (Milton Works). Studied Chemistry at University College, Aberystwyth, and graduated

B.Sc., London Univ. Worked for two years at Göttingen Univ. under Prof. Wallach, and gained the Dr. degree with a Thesis entitled "Beiträge zur Kenntniss der Oxaline." Worked for the British Aluminium Co. at Larne and Milton.

Arthur W. Warrington.
H. Lloyd Snape.
J. Alan Murray.
Edgar Neumann.
J. J. Sudborough.
H. P. Bell.

Bibby, R. Gordon,

New College, Oxford.

Studying Chemistry for Final Honour Schools, Oxford, and proposing to read for the Bar.

William Odling.
W. W. Fisher.
John Watts.
V. H. Veley.
J. E. Marsh.
H. L. Bowman.
Henry A. Miers.
A. F. Walden.

Blackshaw, George Neville,

Agricultural College, Aspatria, Cumberland.

Lecturer in Chemistry. Graduate (B.Sc.) of the University of Wales. Since January, 1902, Lecturer in General and Agricultural Chemistry at the Agricultural College, Aspatria, Cumberland.

Alexander Lauder.
John Golding.
John Frank Blackshaw.
Chapman Jones.
M. J. R. Dunstan.

Calvert, Harry Thornton,

West Riding of Yorkshire Rivers Board.

Chief Chemical Assistant to West Riding of Yorkshire Rivers Board. Joint author of various papers in *Proc.* and *Trans. Chem. Soc.*, 1896, 1898, 1900, 1901. Author of "Die Dielectricitätsconstante des Wasserstoffsuperoxyds" (*Annalen der Physik*, 1900, **4**, I, p. 483); "Die Alkalisalze des Hydroperoxyds" (*Zeitschr. f. phys. Chem.*, **38**, 5, 1901, p. 513), &c. Late 1851 Exhibition Scholar (1898—1901). Late Demonstrator in Chemistry at the Yorkshire College, Leeds. B.Sc. (Vict.) Hons. in Chemistry. Ph.D. (Leipzig University). A.I.C.

Arthur Smithells.
J. B. Cohen.
A. Turnbull.
I. Patchett.
H. M. Dawson.
Thomas Fairley.

Caudwell, Ben,

28, Wigfull Road, Sheffield

Student. B.A. (London), 1895. Have been Schoolmaster (secondary).

At present studying Chemistry at University College, Sheffield. Am desirous of obtaining the publications of the Society.

W. Carleton Williams.
George Young.
William H. Oates.
Percy P. Phillips.
Ernest Witham.
S. Irwin Crookes.

Divine, Thomas,

11, Spencer Place, Roundhay Road, Leeds.

Medical Practitioner. M.B., C.M. (Glasgow). Student of Chemistry, Glasgow University, and at Yorkshire College, Leeds. Interested in Public Health, and desirous of keeping in touch with Chemical Investigation.

T. Stratford Logan.
H. M. Dawson.
H. D. Dakin.
J. B. Leathes.
R. H. Aders Plimmer.

Eastwood, Arthur William,

Newton College, S. Devon.

B.A. (Camb.). Teacher of Chemistry at above College. Desirous of obtaining the literature of the Society.

F. W. Dootson.
K. C. Browning.
R. H. Adie.
T. B. Wood.
R. A. Berry.

Edgerton, John Percy,

39, White Hart Lane, Barnes, S.W.

Analytical Chemist, Assayer, and Gas Examiner. I was Assistant for three years to Leo Taylor, Esq., F.I.C., Public Analyst and Assayer; for 1 year in the laboratory of the Sheffield United Gas Light Co.; for 3½ years to W. C. Young, Esq., F.I.C., F.C.S., Public Analyst. I am Gas Examiner under the London Council; to the Urban District Council of Sunbury-on-Thames, and to the Brentford Gas Co.

John T. Sheard.
John W. Heath.
Robert N. Lennox.
R. Grimwood.
Frank Clowes.
J. H. Coste.
Vivian B. Lewes.
James D. Kettle.
E. T. Shelbourn.
Wm. Jno. Livingston.

Fletcher, Alan,

132, Holland Road Kensington, W.

Research Chemist. For three years student in Chemical Department at Royal College of Science. Now Chemist in the laboratory of Messrs. Oppenheimer, Son, and Co.

William A. Tilden.
W. Palmer Wynne.
M. O. Forster.
H. Burrows.
G. T. Morgan.
G. S. Newth.

Gough, Henry,

c/o John Lovibond and Sons, Limited, Greenwich, S.E.

Brewer and Analyst. Have obtained the Hons. Certificate and also the 1st Prize and Silver Medal of the City and Guilds for brewing. Have passed examinations in chemistry under the Board of Education. A student for three and a half years in the Brewing Department of the Manchester School of Technology. A former student in the Manchester Grammar School.

William J. Pope.
Jas. Grant.
L. G. Radcliffe.
F. S. Sinnatt.
S. J. Peachey.
Francis Jones.

Howsam, George,

School of Science, Art, and Technology, Peterborough.

Lecturer in Chemistry, School of Science, Art, and Technology, Peterborough. Inter. B.Sc., London, First Division. Been for three years in the Laboratory with the Public Analyst of Borough and County Soke of Peterborough.

William Elborne.
James C. Philip.
Chapman Jones.
John B. Coppock.
W. Palmer Wynne.

Jones, Alfred Owen,

18, Queen's Gardens, Tetherdown, Muswell Hill.

Student of Chemistry for three years at University College. Tuffnell Scholar. Am leaving College to take up a position as Works Chemist, and wish to keep informed as to the progress of Chemical Science.

Edward C. Cyril Baly.
William Ramsay.
Morris W. Travers.
J. Norman Collie.
Samuel Smiles.

Kerr, James Stewart,

The Grove, Ladywood Road, Birmingham.

Science Teacher. A.R.C.Sc. (London) in Chemistry. Formerly Science Teacher at Whitehead Road, Birmingham. Science Master, Methodist College, Belfast. Have done, and am doing, work on the bleaching of farinaceous foods.

W. Palmer Wynne. G. T. Morgan.
M. O. Forster. J. C. Philip.
Chapman Jones.

Kirkby, William,

Winster House, Thornfield Road, Heaton Moor, Stockport.

Analytical Manufacturing Chemist. Lecturer in Pharmacognosy in the Owens College for eleven years. Joint author of "Arsenical Poisoning in Beer Drinkers." Author of "The Evolution of Artificial Mineral Waters."

Wyndham R. Dunstan. W. H. Perkin, jun.
Harold B. Dixon. G. H. Bailey.
W. A. Bone.

Lock, John George Collcutt,

17, Berners Street, Oxford Street, W.

Engineering Chemist. In evening class two hours a week during six months studying Metallurgy at King's College, and at present engaged at Metallurgical work. Desirous of obtaining best current chemical literature and use of Reference Library.

A. K. Huntington. H. A. Thiersch.
Arthur C. Claudet. *Francis H. Carr.*
C. H. Desch.

Pond, George Gilbert,

State College, Pennsylvania.

Professor of General Chemistry, Pennsylvania State College. Student at Amherst College, 1878—81; Student at the University of Goettingen, 1881—82; Instructor in Chemistry, Amherst College, 1883—88; Received degree M.A., Amherst College, 1884; Student at the University of Goettingen, 1 semestre, 1885; Professor of Chemistry, The Pennsylvania State College, 1888; Received degree, Ph.D., Amherst College, 1889; Student at the University of Berlin, 1893—94; Dean of the School of Natural Science, The Pennsylvania State College, 1896.—

Jas. Lewis Howe. F. P. Venable.
Chas. Baskerville. Leonard P. Kinnicutt.
Clifford Richardson.

Pitt, Arthur Ernest,

66, Abbott Road, Bromley, E.

Chemist. Studied Chemistry and Allied Subjects for 6 years at the East London Technical College under Professor J. T. Hewitt, being for some time his private assistant. Recipient of two Special Grants from London County Council for Research Work. For 2½ years Chemical Assistant to F. W. Mott, M.D., F.R.S., at the London County Asylum's Pathological Laboratory at Claybury. At present Research Chemist in Messrs. W. J. Bush & Co.'s Laboratory, Hackney, E. Joint Author in the following communications: "Phenetol azophenols" (*Proc. Chem. Soc.*, June, 1897). "Ueber die Salz- und Hydrat-Bildung der Azophenole" (*Ber. deut. Chem. Ges. Bd.*, 31). "The Condensation of Oxalic Acid and Resorcinol" (*Trans. Chem. Soc.*, 1899).

Edgar S. Barralet. de Bush.
J. T. Hewitt. O. J. Silberrad.
J. McCrae.

Pitt, Harold Russell,
8, Church Lane, Charlton, S.E.

Chemist. Second Assistant Chemist and Metallurgist in Royal Laboratory Department, Woolwich Arsenal. In laboratory of H. H. Smith, Esq., F.I.C., for twelve years. Lecturer in Chemistry at Dartford Technical Institute. Assistant lecturer in Department of Chemistry and Metallurgy, Woolwich Polytechnic, under J. B. Farlie, Esq., F.C.S. Pupil of J. B. Farlie, Esq., F.C.S., in Royal Arsenal and Polytechnic Science Schools.

J. B. Farlie. W. Lambert.
R. J. Redding. *W. Kellner.*
A. H. Mundey. *W. H. Deering.*
T. H. Dodd.

Porter, Robert James,
11, Arlington Street, Hull.

Schoolmaster. Successes: Board of Education, Honours Theor. Inorg. Chem. and Honours at Inter. Sc. (Lond.). But chiefly I wish to keep up to date in knowledge of recent work in all branches of Chemistry.

Fras. A. Drake. Thomas Luxton.
Thos. A. Nightscales. Arthur Brooke.
W. H. Templeman.

Robertson, Frederick,
The Hewan, Bearsden, Glasgow.

Analytical Chemist, 128, Wellington Street, Glasgow. Formerly Assistant Chemist, Anderson's Medical School, Glasgow. Lecturer in Chemistry, Western Medical School, Glasgow. Analytical Chemist and Assayer.

Edmund J. Mills. Thomas Gray.
W. Shepperson. *G. G. Henderson.*
James Robson.

Robinson, Archibald Louis,
40, Trinity College, Dublin.

Student. First Scholar in Experimental Science (Dub. Univ.). Senior Moderator and Large Gold Medallist in Experimental Science (Dub. Univ.). B.A. (Dub. Univ.).

J. Emerson Reynolds. Wm. Cecil Ramsden.
Emil A. Werner. *Richard J. Moss.*
W. E. Adeney.

Roose, Fitzroy Owen Jonathan,
Marlow, Oxford Road, Bournemouth, and 49, Hill Street, Mayfair, W.

Electrical Engineer. Associate of Institution of Electrical Engineers. Passed Examination Advanced Chemistry, Science and Art Dept. Assistant Electrical Engineer, Corporation of Bournemouth. Am anxious to keep myself abreast of the modern developments of Physical Chemistry, particularly that bearing on Electricity, to obtain the Journal of the Society, and attend its meetings.

Hugh Erat Harrison. S. Russell Wells.
W. J. Cousins. M. O. Forster.
Frank E. Weston.

Sawdon, Ernest William, B.Sc.,
2, Esk Terrace, Whitby.

Science Master in Friends' School, Saffron Walden, Essex. Have been engaged in teaching since September, 1898. Bachelor of Science (Victoria), 1898. Educated Owens College (1895—1898).

Harold B. Dixon. D. L. Chapman.
W. H. Perkin, jun. Norman Smith.
E. D. Walrond. G. H. Bailey.
W. A. Bone.

Siddle, George.
Middleton-One-Row, R.S.O.

Analytical Chemist. 20 years' experience in Analytical work in

Iron and Steel Works, Chemical and Smelting Works, and in Manufacturing Chemistry.

J. E. Stead.
H. Frankland.
G. H. Saniter.
C. H. Ridsdale.
John Pattinson.

Stevens, Montague White,

2, Richmond Place, Lillie Road, London, S.W.

Assistant Chemist with Messrs. Stanger and Blount of Broadway, Westminster. 3½ years as a Student at Royal College of Science, London, chiefly in Chemistry. A.R.C.Sc. in Chemistry (June, 1902), A.I.C. (Jan., 1903).

William A. Tilden.
M. O. Forster.
Chapman Jones.
G. T. Morgan.
H. Burrows.
J. C. Philip.
W. Palmer Wynne.

Stevenson, Henry Edward,

5, Turner's Road, Bow, London.

Chemist. For six years a student at the East London Tech. Coll., part of the time as private assistant to the Professor, Dr. Hewitt. For two years chemist in Messrs. G. Clark & Son's Sugar Works. Now engaged as a research chemist in the laboratory of Messrs. W. J. Bush & Co., Manufacturing Chemists, Hackney. Joint author of the following papers: (1) The Three Chlorobenzeneazosalicylic Acids (*Trans., J.C.S.*, 1896). (2) Ueber einige von Wroblewski's Bromparatoluidin (*Ber.*, 1898). (3) Die Einwirkung von α-Naphthylamin auf Bromtoluolazosalicylsäure (*Ber.*, [1898], **29**). (4) Notiz über Azophenin (*Ber.*, 1898).

Edgar S. Barralet.
J. T. Hewitt.
de Bush.
O J. Silberrad.
J. McCrae.

Welsford, Giles Hadden,

6, The Orchard, Blackheath, S.E.

Advanced Student of Chemistry. Now working in the Research Laboratory, at the Central Technical College, South Kensington, under Prof. H. E. Armstrong.

Henry E. Armstrong.
Gerald T. Moody.
William A. Davis.
T. Martin Lowry.
Edward W. Lewis.
William Robertson.

Wilkinson, James Bates, M.D., C.M., D.P.H.,
Town Hall, and 6, Edward Street, Oldham.

Medical Officer of Health, Oldham County Borough. Superintendent to Oldham Sewage Works. Consulting M.O.H., Hunts. County Council. Two years in laboratory of F. E. Dembski, B.A., late Public Analyst, Stamford, St. Ives, and Huntingdon. Six months' Laboratory Practice, Owens College, Manchester. Director and Supt. of Chemical Laboratory at the Oldham Sewage Works for the past four years.

James Robt. Kaye.	Gilbert J. Fowler.
Samuel Rideal.	A. S. Wylie.

William. T. Burgess.

Wood, William Francis John,
Hazelhurst, Doncaster Road, Barnsley.

Chemist and Manager of Glass Works. B.Sc. London (1st division), now studying for 1st class honours B.Sc., view to D.Sc., London, under F. W. Richardson, F.I.C., of Bradford. 1st class Honours in S. and A. Practical Chemistry. Qualified Lecturer under County Council in Technical Instruction Classes in Chemistry, Physics, and Geology. Have lectured 3 years and at present am doing so under Barnsley Technical Instruction Committee in Electricity. Chemist and Manager of Borough Flint Glass Works, Barnsley. Three years student of F. W. Richardson, F.I.C., in his laboratories, Bradford, and my services were acknowledged in certain Papers. One on Sulphites, Sulphides, Sulphates, and Thiosulphates in *J.S.C.I.*

F. W. Richardson.	*Thomas Fairley.*
G. W. Slatter.	*Alfred H. Allen.*
H. E. Aykroyd.	*B. A. Burrell.*

Worden, Edward Chancey,
Millburn, New Jersey, U.S.A.

Chemist. Graduate in Chemistry and in Pharmacy, University of Michigan. Chemist at the Government experiment station, Geneva, New York, 1896—97. Chemist for Boston Artificial Leather Co., Celluloid Zapon Co., and Messrs. Richards and Co., 12 E.18th Street, New York City and Millburn, N.J.

Albert B. Prescott.	E. G. Love.
Clifford Richardson.	R. A. Woodcock.

Peter A. Austen.

R. CLAY AND SONS, LTD., BREAD ST. HILL E.C. AND BUNGAY, SUFFOLK.

Issued 30/4/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 265.

Wednesday, April 22nd, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. C. H. Lockitt, A. J. Webb, and A. H. Scholefield were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Henry James Aubrey, The Cross, Worcester.
George Barger, B.A., B.Sc., 50, Guilford Street, W.C.
Charles Drake Bibby, 69, Queens Road, Twickenham.
H. J. W. Brennand, B.A., M.B., Ch. M., 203, Macquarie Street, Sydney.
John Christopher Mann, 9, Lambert Street, Hull.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Henry Guest Adshead.
William Lester St. John Alton.
Harford Montgomery Atkinson, B.Sc.
Robert Gordon Bibby.
George Neville Blackshaw, B.Sc.
Harry Thornton Calvert, B.Sc., Ph.D.
Ben Caudwell, B.A.
Thomas Divine, M.B., C.M.
Arthur William Eastwood, B.A.
John Percy Edgerton.
Alan Fletcher.
Henry Gough.
George Howsam.
Alfred Owen Jones.
James Stewart Kerr.
William Kirkby.
John George Collcutt Lock.
Arthur Ernest Pitt.
Harold Russell Pitt.
George Gilbert Pond, Ph.D.
Robert James Porter.
Frederick Robertson.
Archibald Louis Robinson, B.A.
Fitzroy Owen Jonathan Roose.
Ernest William Sawdon, B.Sc.
George Siddle.
Montague White Stevens.
Henry Edward Stevenson.
Giles Hadden Welsford.
James Bates Wilkinson, M.D., C.M.
William Francis John Wood, B.Sc.
Edward Chancey Worden.

Of the following papers, those marked * were read:—

*59. "The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution." By F. G. Donnan and R. Le Rossignol.

When potassium iodide and ferricyanide react in neutral aqueous solution, free iodine and potassium ferrocyanide are formed, a definite state of equilibrium being attained. If the free iodine is removed as fast as it is formed by means of sodium thiosulphate solution, the velocity of the direct reaction can be investigated by a method similar to that employed by Harcourt and Esson in their fundamental investigation on the speed of chemical reactions. It was found that the reaction proceeded according to the equation: $-dc/dt = kc_1^2c_2^3$, where c_1 = concentration of ferricyanogen ions, and c_2 = concentration of iodine ions.

The simplest interpretation of this equation is that the primary reaction involves *two* ferricyanogen ions and *three* iodine ions according to the equation: $2\overset{---}{\mathrm{Fe(CN)_6}} + 3\overset{-}{\mathrm{I}} = 2\overset{----}{\mathrm{Fe(CN)_6}} + \overset{-}{\mathrm{I_3}}$.

The exponents 2 and 3 of the velocity-equation were determined by separate variations of the ferricyanide and iodide concentrations.

The foregoing account of the mechanism of the reaction does not, however, explain all the experimental results, inasmuch as it gives no explanation of the peculiar fact that although the reaction appears to be bimolecular with respect to the ferricyanogen ions (the concentration of the iodine ions remaining constant), nevertheless, the velocity-coefficient varied with the *initial* concentration of the potassium ferricyanide.

A theory which appears to be capable of giving a quantitative interpretation of all the observed results may be briefly summarised as follows:

1. The actual reaction is assumed to occur between free *ferric* ions and iodine ions according to the equation, $2\overset{+++}{\mathrm{Fe}} + 3\overset{-}{\mathrm{I}} = 2\overset{++}{\mathrm{Fe}} + \overset{-}{\mathrm{I}_3}$.
2. The ferric ions in question are assumed to result from an extremely small dissociation of the ferricyanogen ions into ferric and cyanogen ions.
3. The degrees of dissociation of the ferricyanogen and ferrocyanogen ions are assumed to be the same, or practically the same, in solutions containing the same number of equivalents.

DISCUSSION.

Sir WILLIAM RAMSAY said that Mr. Le Rossignol's reaction was the first quinquemolecular reaction which, so far as he knew, had been investigated. It might appear almost incredible that free iron ions should exist in a solution of potassium ferricyanide, but it must be remembered that their concentration was so low that the most delicate tests for iron, namely, the ferrocyanide and ferricyanide reactions, failed to detect them. Mr. Le Rossignol had made an experiment in which he had electrolysed some potassium ferrocyanide, and he had obtained, after a long time, a deposition of metallic iron on the cathode; this, of course, might be due to a secondary reaction, but, so far as it went, it was in corroboration of the theory.

*60. "A microscopic method of determining molecular weights. A preliminary note." By G. Barger.

When two solutions of equal vapour tensions, produced by dissolving two substances in the same solvent, are left in a closed chamber, their volumes will not alter after the chamber has become saturated with the vapour of the solvent. If, however, the vapour tensions are unequal, the solvent will distil from the solution with the greater vapour tension into that with the less.

As the result of a suggestion by Prof. L. Errera, of the botanical laboratory of Brussels University, to the effect that this principle might be used for determining molecular weights, the author has elaborated a method, which apparently differs in certain essential features from those hitherto published, and is briefly as follows: A standard solution of the substance, the molecular weight of which is to be determined, is compared with a number of standard solutions of a substance of known molecular weight.

Small quantities of the two solutions which are being compared are introduced into a capillary tube, where they form bi-concave, discoid drops, care being taken to use the solutions alternately, so that each drop of one solution is enclosed between two drops of the other. The capillary tube is then sealed at both ends, and the length of each drop is measured under the low power of a microscope with the aid of an eye-piece micrometer. After a few hours, or a day, the measurement is repeated, when, if the vapour tensions of the two solutions are unequal, the drops of one series are found to have increased in size, whilst the others have correspondingly diminished.

By using standard solutions of various strengths, an approximate value for the molecular weight is obtained, the limit of accuracy attained at present being about 10 per cent.

The method will undoubtedly be useful in deciding between multiples of an empirical formula in those cases where ebullioscopic methods are not available.

*61. "Note on the spectrum of pilocarpine nitrate."

By W. N. Hartley.

In the current number of the *Transactions*, p. 452, there is a representation of the absorption curve of pilocarpine nitrate as determined by Professor Dobbie.

In the author's opinion, the curve is that characteristic of nitric acid, and is only indirectly associated with pilocarpine, certainly not belonging, or peculiar to, this alkaloid. On comparing the diagram with the curve common to nitric acid and potassium nitrate (*Trans.*, 1902, **81**, 558), the similarity is easily recognised.

Although there are slight differences of detail in the absorption band, these are due to the recorded measurements not being made at exactly the same points or with solutions of the same concentration, and also in part to a slight modification of the nitric acid curve caused by the pilocarpine molecule.

Pilocarpine, if examined by itself or as a salt of any diactinic acid such as hydrochloric, acetic, or sulphuric acid, will be found to exhibit no absorption band.

This may be predicted both from the fact that pilocarpine nitrate is highly diactinic, and that stronger solutions than are usually employed were necessary in order to obtain clear indications of the absorption band, and also from the composition and structure of the molecule, the evidence for which is adduced by Dr. Jowett. It is probable that pilocarpine and *iso*pilocarpine are not structurally different, although the manner in which they were examined does not justify the conclusion that their absorption curves are identical. It is not safe to draw inferences from solutions of nitrates of the alkaloids, particularly when the bases themselves exert but little absorption. In such cases, a more searching examination might disclose differences between the alkaloids. As the communication neither refers to the existence of the absorption band of nitric acid nor contains evidence of the absorption caused by pilocarpine and of *iso*pilocarpine alone or in combination with a highly diactinic acid, it might be supposed from a study of the paper that pilocarpine was characterised by an absorption band, but this is certainly not the case. It is evident that, as with caffeine, digitaline, and similar alkaloids (*Phil. Trans.*, 1885, **176**, 471), the structure of pilocarpine does not confer on the base any peculiar absorptive power or selective absorption.

Discussion.

Dr. Dobbie said that the purpose of Professor Hartley's note was not to call in question the validity of the conclusion that pilocarpine and *iso*pilocarpine are probably isomerides, which had been based on the comparison of their nitrates, but to point out that no information as to the chemical structure of these bases could be derived from the fact that concentrated solutions of their nitrates showed a well-marked absorption band.

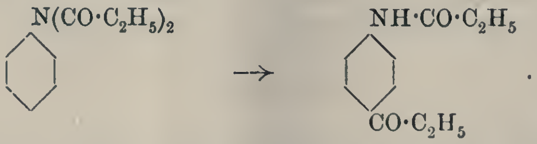
Such bands are usually, in the case of organic compounds, associated with the possession of a benzenoid, pyridine, or similar nucleus, but, inasmuch as nitric acid itself in concentrated solution gives a well-marked absorption band, the presence of a band in the nitrates examined afforded no evidence of the presence of such a nucleus in the alkaloids. The band of pilocarpine, and of *iso*pilocarpine nitrate, occupies the same position, and is very similar to, without being actually identical with, the band of nitric acid. Professor Hartley regards it as the band of nitric acid modified by the presence of the alkaloid. It is this modification of the band which is of importance in relation to the comparison between pilocarpine and *iso*pilocarpine, instituted in Dr. Jowett's paper. Since the modification is exactly the same in both cases, the conclusion that pilocarpine and *iso*pilocarpine must have the same chemical structure remains unaffected.

In this case, it was necessary to use concentrated solutions of the nitrates for the investigation, because it was found impossible to obtain satisfactory solutions of the free bases.

In the case of alkaloids of high molecular weight, such as berberine, the absorption spectra of dilute solutions of the nitrate are practically the same as those of the chloride, and wholly different from the spectra of nitric acid. Professor Hartley's caution as to the employment of nitrates in the investigation of chemical structure by the spectroscopic method applies, therefore, more particularly to those highly diactinic substances, which, like pilocarpine, have comparatively low molecular weights.

62. "Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone." By F. D. Chattaway.

Under the influence of various reagents, dipropionanilide, like diacetanilide and dibenzanilide, undergoes transformation into propionyl-*p*-aminopropiophenone :



Although the *o*-derivative is probably also formed in small amount, only the *p*-derivative can be isolated in quantity. As a catalytic agent, zinc chloride gives the best yield, but hydrogen chloride is also applicable, the transformation being most readily effected by heating propionanilide dissolved in an equivalent amount of propionic anhydride with about one-third its weight of dry powdered zinc chloride for 12 to 16 hours at 140—150°.

The product, after hydrolysis with alcoholic hydrogen chloride, is rendered alkaline and distilled in steam, the *p*-aminopropiophenone separating from the residual solution in reddish-yellow plates (yield = 50 per cent.). The base, which is obtained colourless by crystallisation from alcohol or chloroform, separates in flattened rhombs (m. p. 142°) ; its acetyl derivative forms colourless, hexagonal prisms (m. p. 175°). Kunckell (*Ber.*, 1900, 33, 2641) describes these compounds as crystallising in yellow needles melting respectively at 140° and 161°.

p-*Aminopropiophenone sulphate*, $(C_2H_5\cdot CO\cdot C_6H_4\cdot NH_2)_2,H_2SO_4$, a sparingly soluble salt, forms anhydrous, colourless plates which become red and decompose at 223° ; the *platinichloride*,

$$(C_2H_5\cdot CO\cdot C_6H_4\cdot NH_2)_2,H_2PtCl_6,$$

forms small, orange-coloured needles.

p-*Acetylchloroaminopropiophenone*, $C_2H_5\cdot CO\cdot C_6H_4\cdot NClAc$, colourless plates, m. p. 75° ; p-*acetylbromoaminopropiophenone*, short, yellow prisms, m. p. 115° ; p-*propionylaminopropiophenone*,

$$C_2H_5\cdot CO\cdot C_6H_4\cdot NH\cdot CO\cdot C_2H_5,$$

slender, colourless prisms, m. p. 153°; p-*propionylchloroaminopropiophenone*, $C_2H_5 \cdot CO \cdot C_6H_4 \cdot NCl \cdot CO \cdot C_2H_5$, colourless plates, m. p. 80°; p-*propionylbromoaminopropiophenone*, pale yellow, elongated plates, m. p. 120°; p-*benzoylaminopropiophenone*, $C_2H_5 \cdot CO \cdot C_6H_4 \cdot NH \cdot CO \cdot Ph$, thin, colourless, elongated plates, m. p. 190°; p-*benzoylchloroaminopropiophenone*, $C_2H_5 \cdot CO \cdot C_6H_4 \cdot NCl \cdot CO \cdot Ph$, colourless plates, m. p. 70°; p-*benzoylbromoaminopropiophenone*, bright yellow, rhombic plates, m. p. 111°.

When heated quickly, the nitrogen-halogen derivatives all undergo transformation at about 200—230° with much decomposition.

63. "Note on the formation of di- and hexa-methylammonio-cadmium chlorides." By W. R. Lang.

Dry methylamine and cadmium chloride react at $-11°$, but not at $-80°$, to form a white powder, corresponding with the formula $CdCl_2,6CH_3 \cdot NH_2$. When heated to 100°, a stable substance is obtained having the composition $CdCl_2,2CH_3 \cdot NH_2$, its decomposition is not complete at 300°.

ADDITIONS TO THE LIBRARY.

II. By Purchase.

Glaser, Christopher. The Compleat Chymist, or a New Treatise of Chymistry. Teaching by a short and easy method all its most necessary Preparations. Written in *French* by *Christopher Glaser*, Apothecary in Ordinary to the *French King*, and the *Duke of Orleans*. And from the fourth Edition, Revised and Augmented by the Author. *Now* faithfully *Englished* by a *Fellow* of the *Royal Society*. Illustrated with Copper Plates. London 1677.

III. Pamphlets.

Bull, Irving C. On the determination of lead in ores. (*From the School of Mines Quarterly*, 1902, **23**, p. 348.)

Cutolo, Alessandro. Sulla ricerca delle sostanze coloranti artificiali negli alimenti in decomposizione. (*From the Bull. Soc. Nat. Napoli*, **15**, 1901.)

—— Brodo di sangue (nuovo terreno di cultura). (*From the Bull. Soc. Nat. Napoli*, **16**, 1902.)

Doane, Charles F., and Price, T. M. The influence of preservatives upon the food value of milk. (*Bull. No.* 86, *Maryland Agric. Exper. Station,* 1902.)

Thomsen, Julius. Fremgangsmaade, ved hvilken det hidtil hypotetiske stof Enkelt-svovlkulstof (CS.) med lethed kan dannes. 1902.

Van Slyke, L. L., and Hart, E. B. A study of some of the salts formed by casein and paracasein with acids; their relations to American cheddar cheese (*being Bull. No.* 214, *New York Agric. Exper. Station,* 1902).

Guthrie, Frederick Bickell. Analysis of Prickly Pear. 1900.

Colorado. The University of Colorado Studies. Vol. I. No 2. 1902.

Stieglitz, Julius. On the "Beckmann rearrangement." (University of Chicago Decennial Publications.) Chicago 1903.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next meeting, on **Thursday,** May 7th, at **8** p.m., the following papers will be communicated:

"β-Bromonitrocamphor and β-bromocamphoryloxime. Influence of impurities in conditioning dynamic isomerism." By T. M. Lowry.

"The spontaneous decomposition of nitrocamphor." By T. M. Lowry.

"The active constituents of *Butea Frondosa.*" By E. G. Hill.

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Issued 15/5/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 266.

Thursday, May 7th, 1903. Professor H. McLeod, F.R.S., Vice-President, in the Chair.

Messrs. F. H. Lees, R. Seligman, D. J. Williams, G. H. Welsford, and E. Gumersall were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Ernest Bury, M.Sc., Brackley Coke Works, Little Hulton.
Thomas Campbell, Rosemount Villa, Queens Road, Bradford.
Albert James Carrier, B.Sc., 30, Kingwood Road, Bath,
Francis Gerald Harmer, Middle Class School, Leeds.
Frank William G. King, 15, Almond Road, Lower Tottenham, N.
Charles E. L. Livesey, St. Bede's Grammar School, Bradford.
Charles S. Purcell, 37, Acomb Street, Greenheys, Manchester.
Dennis Tyrrell, 182, King Street, Norwich.

The Chairman announced that the Council at its meeting that day had awarded the Longstaff Medal to Professor W. J. Pope, F.R.S., for his researches on the stereochemistry of compounds of elements other than carbon.

Of the following papers, those marked * were read:

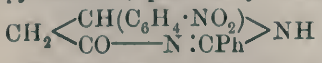
*64. "The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. Part II."

By S. Ruhemann.

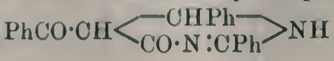
The olefine-β-ketocarboxylic esters may be obtained by the action of hydrogen chloride, not only on the dry mixture of an aldehyde and a β-ketonic ester, but also on their solutions in alcohol or benzene. In some cases, this method may be found more convenient than that recommended by Knoevenagel (*Ber.*, 1896, **29**, 172), according to which aldehydes react with β-ketonic esters in the presence of amines to yield either olefine-β-ketonic esters or saturated diketonic esters, the result depending on the temperature. It has now been found that piperidine, when added to a mixture of ethyl benzoylacetate and benzaldehyde, readily induces the formation, not of the saturated diketonic ester, but of the olefine-β-ketonic ester, ethyl benzylidenebenzoylacetate, $PhCO\cdot C(CO_2Et):CHPh$.

The author also showed that diethylamine effects, although much more slowly than piperidine, the formation of ethyl benzylideneacetoacetate, and that on adding the base to the alcoholic solution of benzaldehyde and ethyl benzoylacetate, the diketonic ester, $PhCH(CHBz\cdot CO_2Et)_2$, is obtained. This ester melts at 115—116°, the fused product solidifies on cooling, and then melts at 129—130°. These results differ from Knoevenagel's observation, according to which ethyl benzylidenebisbenzoylacetate melts at 95°. The difficulty with which ethyl benzoylacetate yields, with aromatic amines, diketonic esters is attributed to the stereochemical influence exercised by the phenyl group of the ester.

The esters of benzylidenebenzoylacetic, *m*-nitrobenzylideneacetoacetic, and *m*-nitrobenzylidenebenzoylacetic acids react with benzamidine in a manner similar to ethyl benzylideneacetoacetate (*Trans.*, 1903, **83**, 374); they lose either the acetyl group as ethyl acetate, or the benzoyl group as ethyl benzoate, and yield dihydrodiphenylpyrimidone, previously described (*loc. cit.*), or its nitro-derivative,



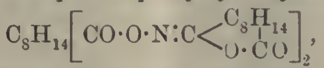
$CH_2<\begin{matrix}CH(C_6H_4\cdot NO_2)\\ CO——N:CPh\end{matrix}>NH$ (m. p. 192—193°).

In the case of the action of benzamidine on ethyl benzylidenebenzoylacetate, it has been found that the benzoyl group is only partially removed, and that, besides dihydrodiphenylpyrimidone, its benzoyl derivative,  $PhCO\cdot CH<\begin{matrix}—CHPh—\\ CO\cdot N:CPh\end{matrix}>NH$ (m. p. 241—242°), is produced.

Ethyl *m*-nitrobenzylidenemalonate reacts with benzamidine to form $NO_2\cdot C_6H_4\cdot CH<\begin{matrix}CH(CO_2Et)\cdot CO\\ NH\text{——}CPh\end{matrix}>N$ (m. p. 181—182°), a compound which, under the influence of ammonia, undergoes a transformation similar to that of ethyl dihydrodiphenylpyrimidonecarboxylate (*loc. cit.*), and yields dihydro-*m*-nitrophenyl-phenylpyrimidone (m. p. 192—193°).

*65. "Spontaneous decomposition of nitrocamphor." By T. M. Lowry.

A quantity of nitrocamphor, prepared in 1898 and purified by recrystallising once from alcohol, was found to have undergone change, although a smaller specimen, which had been further purified and crystallised from benzene, was unaltered; 175 grams of the changed material gave 85 grams of crystalline nitrocamphor and 55 grams of a neutral substance sparingly soluble in spirit. This product, which melted at 256°, dissolved in acetone to the extent of 3·22 grams in 100 c.c. of solution at 13° and gave $[\alpha]_D = +33°$ in acetone. The substance is not readily acted on either by boiling hydrochloric acid or by alcoholic potash, but is oxidised to camphoric acid by heating with nitric acid at 100°. Molecular weight determinations in boiling benzene solution showed it to be a trimolecular compound, formed by the condensation of three molecules of nitrocamphor. One atom of nitrogen is eliminated in the condensation, probably as a result of the oxidation of 1 mol. of nitrocamphor to camphoric anhydride, and the analytical data agree with those required by the equation: $C_8H_{14}<\begin{matrix}CO\\ CO\end{matrix}>O + 2C_{10}H_{15}NO_3 = C_{30}H_{42}N_2O_8 + H_2O$. The substance has therefore the composition of a camphoric ester derived from nitrocamphor or one of its isomerides, and has been found to be identical with a *sesqui-camphorylhydroxylamine*,

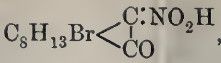


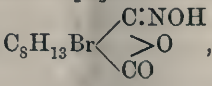
$$C_8H_{14}\left[CO\cdot O\cdot N{:}C<\begin{matrix}C_8H_{14}\\ |\\ O\cdot CO\end{matrix}\right]_2,$$

prepared from camphoryl chloride and camphoryloxime.

*66. "β-Bromo-α′-nitrocamphor and β- and π-bromocamphoryloximes. The influence of impurities in conditioning isomeric change." By T. M. Lowry.

β-Bromo-α′-nitrocamphor, $C_8H_{13}Br<\begin{matrix}CH\cdot NO_2\\ |\\ CO\end{matrix}$, prepared by reducing αβ-dibromo-α′-nitrocamphor with alcoholic potash, differs greatly from nitrocamphor, but closely resembles π-bromonitrocamphor.

The *pseudo*-form,  $C_8H_{13}Br<\begin{matrix}C{:}NO_2H\\ |\\ CO\end{matrix}$, separates in a pure state when a solution of the nitro-compound in benzene or ethyl acetate is slowly evaporated; it melts with slight decomposition at 132°, crystallises again on cooling, and remelts at or below 96°. The *normal* form was not isolated; a solution in methyl alcohol when slowly evaporated, gave a mixture of the two forms, and a solution in formic acid underwent isomeric change. A mixture of the two forms, obtained by crystallising from hot alcohol or acetic acid, softened at 100°, melted without decomposition at about 114°, and remelted sharply at 100°; the latter is therefore the temperature at which the solid *pseudo*-form is in stable equilibrium with the liquid mixture. The *potassium* salt of the *pseudo*-form crystallises from water in glistening needles with $2H_2O$ and is strongly dextrorotatory; the specific rotatory power of the nitro-compound in the salt is $[\alpha]_D = +103°$.

β-Bromocamphoryloxime,  $C_8H_{13}Br<\begin{matrix}C{:}NOH\\ >O\\ CO\end{matrix}$, prepared by heating the nitro-compound with hydrochloric acid, separates from water in minute needles with $1H_2O$ and melts at 111°. The anhydrous oxime crystallises from benzene in glistening needles; a solution in chloroform saturated at 13° contains 2·20 grams in 100 c.c. and gives $[\alpha]_D = +10°$. The *acetyl* derivative crystallises from ethyl alcohol in minute flakes, melts at 112°, and has $[\alpha]_D = +3°$ in acetone. The *benzoyl* derivative crystallises from alcohol in needles, melts at 134°, and has $[\alpha]_D = +11°$ in acetone; unlike nitrocamphor, which gives the camphoryloxime benzoate, the potassium salt of *pseudo-β*-bromonitrocamphor could not be benzoylated by the Schotten-Baumann method.

π-Bromocamphoryloxime, isomeric with the preceding compound, was prepared synthetically from π-bromocamphoric anhydride and hydroxylamine, and is identical with the *iso*-π-bromonitrocamphor which Lapworth (*Trans.*, 1896, 69, 304) obtained by boiling π-bromonitrocamphor with hydrochloric acid; the acetyl derivative melts at 171° and the *benzoyl* derivative at 185°.

Freshly prepared solutions of β-bromo-α′-nitrocamphor exhibit the phenomenon of mutarotation. A solution in benzene of the *pseudo*-form is at first almost inactive (three specimens gave $[\alpha]_D = +2°$, 0°, and $-4°$), but in the course of 2 or 3 days the specific rotatory power becomes constant with $[\alpha]_D = -80°$.

The change of rotatory power is not spontaneous, but is conditioned by the presence of traces of impurity.

Three solutions in benzene of a mixture of normal and *pseudo-β*-bromonitrocamphor were prepared; part of each solution was at once transferred from the graduated flask to a tube and examined in the polarimeter, and in each case a gradual change of rotatory power from − 72° to − 80° was observed during the first 24 hours; a few days later, the remainder of the solution in the flask was also transferred to a tube and examined; in one case only had a state of equilibrium been reached, whereas the other two solutions still exhibited their initial rotatory power, although an interval had elapsed three or four times as long as that normally required for the attainment of equilibrium.

Previous observations have shown that normal nitrocamphor does not change spontaneously on dissolution; the facts now recorded show, further, that even when both isomerides are present in solution, equilibrium between them is only established in presence of a catalytic agent, probably an alkali. A final proof is thus afforded that isomeric change, even when it consists merely in the transference of a mobile hydrogen atom, cannot be accomplished within the molecule, and can only be brought about by an intermolecular mechanism, involving at least three molecules and obeying the ordinary laws of chemical change. The phenomena are closely analogous to Baker's observations on the union of hydrogen and oxygen, and are directly opposed to Laar's hypothesis of "tautomerism."

DISCUSSION.

Dr. LAPWORTH stated that the important observation that mutarotation did not occur in a solution containing a mixture of the two isomeric bromonitrocamphors found a parallel in the behaviour of camphorquinonehydrazone, for the mutarotation of this substance could apparently be arrested by the introduction of an acid at any stage, and therefore when both forms are present.

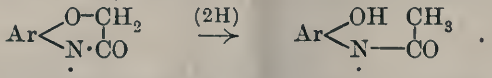
Although Dr. Lowry appeared to conclude that changes of this character were effected by the catalytic agents and would not occur in their absence, yet the usual assumption that the velocity simply becomes immeasurably small in the absence of catalysts seemed to meet the case as well as ever. In the absence of experimental methods for deciding between the two hypotheses, it was impossible to say which view was correct.

Dr. FORSTER suggested that, in order to avoid confusion arising from the notation of the new derivatives, the name β-bromonitrocamphor should be furnished with an affix indicating the position of the nitro-group, and asked whether Dr. Lowry had obtained fresh chemical evidence leading him to continue the representation of the *pseudo*-nitro-group by Hantzsch's original *iso*nitro-formula, which had been abandoned by chemists generally in favour of the nitronic representation.

In reply, Dr. Lowry stated that the rotatory power of the labile solutions was probably not absolutely constant, as it was impossible, in practice, to prepare absolutely pure solutions; in some cases, an appreciable change could be detected, but in others the rotatory power was quite constant within the limits of experimental error. With regard to the notation of the nitro-derivatives, the nitro-group was probably not in the α- but in the stereoisomeric α'-position. The formula assigned to *pseudo*-nitrocamphor was in accordance with Perkin's observations on the magnetic rotatory power of the substance, which showed that the nitrogen was probably tervalent, and was also analogous to the formula generally adopted for the *iso*oximes.

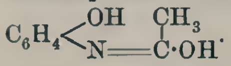
*67. "The electrolytic reduction of pheno- and naphtho-morpholones." By F. H. Lees and F. Shedden.

When phenomorpholone, *N*-methylphenomorpholone, and *N*-methyl-β-naphthomorpholone are electrolytically reduced in sulphuric acid, the first stage of the reduction involves for the most part a disruption of the morpholone ring according to the scheme:



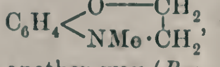
$$\mathrm{Ar}<\begin{matrix}\mathrm{O-CH_2}\\ \mathrm{N\cdot CO}\end{matrix} \xrightarrow{(2H)} \mathrm{Ar}<\begin{matrix}\mathrm{OH\quad CH_3}\\ \mathrm{N—CO}\end{matrix}.$$

In the case of phenomorpholone, the final products are acetyl-*o*-aminophenol, ethyl-*o*-aminophenol, and iso*acetyl*-o-*aminophenol*,



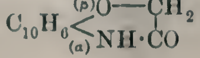
$C_6H_4<\begin{matrix}\mathrm{OH\quad CH_3}\\ \mathrm{N{=\!=}C\cdot OH}\end{matrix}$. The third of these substances crystallises from alcohol in glistening leaflets, and melts at 190° with evolution of water vapour and the simultaneous formation of ethenyl-*o*-aminophenol; this behaviour differentiates it from acetyl-*o*-aminophenol, which melts at 205° and is only partially converted into the ethenyl-base at a temperature approaching 300°. The formation of *iso*acetyl-*o*-aminophenol is probably due to the existence in solution of two desmotropic forms of phenomorpholone, these isomerides each undergoing disruption during reduction in accordance with the foregoing scheme.

N-Methylphenomorpholone gives N-*acetylmethyl*-o-*aminophenol*, $C_6H_4(OH)\cdot NMeAc$, which separates from methylal in needles melting at 150°; N-*methylethyl*-o-*aminophenol*, $C_6H_4(OH)\cdot NMeEt$, the *hydrochloride* of which forms plates melting at 150°; and *N*-methylphenomorpholine,

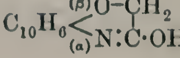


$C_6H_4<\begin{matrix}\mathrm{O—CH_2}\\ \mathrm{NMe\cdot CH_2}\end{matrix}$, which is identical with that obtained by Knorr in another way (*Ber.*, 1889, **22**, 2081).

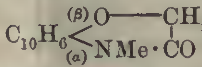
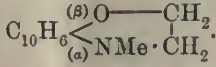
β-Naphthomorpholone,



$C_{10}H_6\begin{matrix}^{(\beta)}\mathrm{O—CH_2}\\ _{(\alpha)}\mathrm{NH\cdot CO}\end{matrix}$ or



$C_{10}H_6\begin{matrix}^{(\beta)}\mathrm{O-CH_2}\\ _{(\alpha)}\mathrm{N:C\cdot OH}\end{matrix}$, was prepared by the reduction of *α-nitro-β-naphthoxyacetic acid*, $C_{10}H_6(NO_2)\cdot OCH_2\cdot CO_2H$, the latter being obtained by two methods; (1) by nitrating β-naphthoxyacetic acid; (2) by condensing the potassium salts of α-nitro-β-naphthol and chloroacetic acid in aqueous solution. The nitro-acid separates from acetic acid in yellow prisms and melts at 188—189°; the morpholone obtained from the same solvent forms colourless needles and melts at 215—216°.

N-*Methyl-β-naphthomorpholone*,  $C_{10}H_6<\begin{matrix}{}^{(\beta)}O\text{——}CH_2\\ {}_{(\alpha)}NMe\cdot CO\end{matrix}$, crystallises from alcohol in long, colourless needles melting at 84—85°. When reduced, it gives N-*methylethyl-α-amino-β-naphthol*, $C_{10}H_6(OH)\cdot NMeEt$, and N-*methyl-β-naphthomorpholine*,  $C_{10}H_6<\begin{matrix}{}^{(\beta)}O\text{——}CH_2\\ {}_{(\alpha)}NMe\cdot CH_2\end{matrix}$. The former distils at 193° (corr.) under 40 mm. pressure and is a light yellow oil solidifying on cooling to needles which melt at 25—27°; the *sulphocamphylate*, $C_{13}H_{15}ON\cdot C_9H_{14}O_5S,H_2O$, separates from water in prismatic needles melting at 203—204°; the *hydriodide* crystallises from a mixture of acetone and ether in needles which melt at 183°; the *acetyl* derivative, $C_{13}H_{14}N\cdot OAc$, is a colourless oil boiling at 212—215° (corr.) under 40 mm. pressure. The morpholine distils at 220—222° under 40 mm. pressure as a viscid, light-yellow oil, having a blue fluorescence and a faintly basic odour; the *sulphocamphylate*, $C_{13}H_{13}ON\cdot C_9H_{14}O_5S,H_2O$, forms needles melting at 196°; the *methiodide*, $C_{13}H_{13}ON\cdot MeI$, separates in needles melting at 163—164° with evolution of methyl iodide.

DISCUSSION.

Mr. GROVES asked whether the authors had tried to reduce morphine electrolytically, and, if so, whether its morpholine ring underwent disruption in the manner observed with pheno- and naphtho-morpholones.

Mr. LEES, in reply, said that in connection with another investigation he had found that morphine is not changed when subjected to electrolytic reduction. Pheno- and naphtho-morpholones are aryloxy-compounds, whereas in morphine the ether-oxygen atom is attached to a partially reduced aromatic nucleus.

68. "The coloured constituents of Butea frondosa."

By E. G. Hill.

The dried and fresh flowers of *Butea frondosa* are extensively used in India for the preparation of a somewhat fugitive yellow dye.

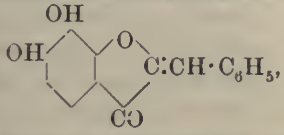
The aqueous extract of the flowers contains an easily decomposable tannin which readily yields phlobaphen; this product, which separates from the solution as a dark, tarry precipitate on boiling with hydrochloric acid, is almost insoluble in warm water, but readily dissolves in alcohol or in aqueous alkalis; from the former solution, it is reprecipitated by water, and from the latter by acids. On evaporating the filtrate from the phlobaphen, an odour of charred sugar was noticed, this result suggesting the presence of a glucoside.

The freshly-prepared extract, when treated with lead acetate, yielded a yellow precipitate of a lead salt which, when suspended in water and decomposed by hydrogen sulphide, furnished a yellow solution, from which a yellow gum was obtained by evaporation. This product, when dissolved in water and extracted with ether, gave a light yellow ethereal solution, from which a semi-fibrous, yellow mass separated. This substance was soluble in hot water, alcohol, or acetic acid, and separated from the last-mentioned solvent in small, lemon-yellow crystals, which gave the reactions of fisetin (compare Perkin and Hummel, *J. Soc. Chem. Ind.*, 1895, 459, and Hummel and Cavallo, *Proc.*, 1894, 10, 11). At the time this work was carried out, the author had no access to the original papers of the foregoing authors.

After separating the ethereal extract, the aqueous solution was hydrolysed by boiling with dilute hydrochloric acid; this reaction led to the precipitation of phlobaphen, several fractions of the product being collected during evaporation.

These fractions, which are probably different anhydrides of the same tannin, were all readily soluble in alcohol or aqueous alkalis, giving rise to deep reddish-brown solutions; they readily reacted with bromine, evolving hydrogen bromide and giving an amorphous powder lighter in colour than the original substance; this product yielded traces of methyl bromide on treatment with sodium hydroxide solution. Phloroglucinol and protocatechuic acid were obtained from the phlobaphen by fusion with potassium hydroxide.

69. "Butein. A preliminary notice." By (the late) J. J. Hummel and A. G. Perkin.

The announcement (this vol., p. 126) that a paper by E. G. Hill on "The Coloured Constituents of *Butea frondosa*" would be read at the next meeting of the Society, renders necessary the following note on the investigation of this dyestuff, which is now proceeding. *Butein*, the colouring matter of the flowers of *B. frondosa* (Hummel and Cavallo, *Proc.*, 1894, 10, 11), $C_{15}H_{10}O_5$, probably exists in two modifications: (*a*) colourless ($C = 66{\cdot}62$; $H = 4{\cdot}32$), and (*b*) orange-yellow ($C = 66{\cdot}31$; $H = 4{\cdot}19$), which, on fusion with alkali, give resorcinol and protocatechuic acid. The *tribenzoyl* derivative, $C_{15}H_7O_5(C_7H_5O)_3$ ($C = 74·02$; $H = 4·05$), which forms colourless needles (m. p. 155—157°), and the *triacetyl* compound, $C_{15}H_7O_5(C_2H_3O)_3$ ($C = 63·50$; $H = 4·05$) have been studied. The dyeing properties of butein very closely resemble those of benzylideneanhydroglycogallol (Friedländer and Rudt, *Ber.*, 1896, **29**, 879), 

the compound being probably a member of this or some closely allied series. When it is heated with sulphuric acid, a colouring matter is produced, the tinctorial properties of which are somewhat similar to those of alizarin.

70. "The relative affinities of polybasic acids." By H. M. Dawson.

The conceptions of avidity, as defined originally by Thomsen, and of affinity, as based on the theory of electrolytic dissociation, are not always identical.

For weak polybasic acids, the relative affinities are determined essentially at all ordinary concentrations by the primary dissociation of a single hydrogen ion, and direct values for the affinities as measured by their base combining powers will be obtained if the quantities of the two acids competing for a base are in the ratio of their molecular and not their equivalent weights.

In the case of strong polybasic acids, the affinity is a complex factor determined by more than one dissociation phenomenon, and a method of viewing such partition phenomena in the case of the stronger polybasic acids is brought forward.

71. "The chemical dynamics of the reactions between chlorine and benzene under the influence of different catalytic agents and of light." By A. Slator.

With a large excess of benzene, the reactions between this hydrocarbon and chlorine are practically limited to the two changes represented by the following equations: $C_6H_6 + Cl_2 = C_6H_5Cl + HCl$, $C_6H_6 + 3Cl_2 = C_6H_6Cl_6$, the relative amounts of the two chief products depending on the conditions of the experiment.

The velocity of these reactions has been measured under various conditions, especially under the influence of different catalytic agents. A chlorine solution of suitable concentration in dry benzene being employed, the velocity of the reactions is measured by simultaneous titrations of chlorine and hydrogen chloride.

The reaction velocity without a catalytic agent is too small to be measured. Under the influence of iodine chloride, both the substitution and addition reactions take place. The velocity of disappearance of free chlorine is found to be proportional to the chlorine concentration and to the square of the iodine chloride concentration; the temperature coefficient of the reaction is very small. By investigating the reaction in carbon tetrachloride solution with varying quantities of benzene, it was shown that the velocity is proportional to the concentration of the hydrocarbon. It is found by estimating the hydrogen chloride that 70 per cent. of the chlorine takes part in the substitution reaction, whilst the remainder combines additively.

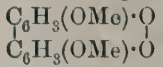
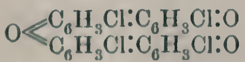
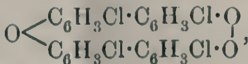
This ratio remains constant, even when the solvent is changed or the concentration of chlorine, iodine chloride, or benzene varied; it is also only slightly affected by temperature.

With tin tetrachloride and with ferric chloride as catalytic agents, the substitution reaction alone takes place. The accelerating effect due to a mixture of iodine chloride and tin tetrachloride is found to be approximately equal to the sum of that due to each agent acting separately.

Under the influence of light without catalytic agents, the addition reaction alone occurs; under conditions of equal illumination, the velocity of this change is found to be proportional to the square of the chlorine concentration.

72. "The diazo-reaction in the diphenyl series. Part I. On dianisidine and 3 : 3′-dichlorobenzidine." By J. C. Cain.

On heating aqueous solutions of the diazonium salts prepared from dianisidine and 3 : 3′-dichlorobenzidine, dark coloured, insoluble, infusible compounds are obtained instead of the expected dihydroxy-derivatives.

The products, which appear to be quinones, agree in composition with the formulæ $O:C_6H_3(OMe):C_6H_3(OMe):O$ or  $\begin{array}{l} C_6H_3(OMe)\cdot O \\ | \qquad\qquad\quad | \\ C_6H_3(OMe)\cdot O \end{array}$ and  $O\begin{array}{l} \diagup C_6H_3Cl:C_6H_3Cl:O \\ \diagdown C_6H_3Cl:C_6H_3Cl:O \end{array}$ or  $O\begin{array}{l} \diagup C_6H_3Cl\cdot C_6H_3Cl\cdot O \\ \diagdown C_6H_3Cl\cdot C_6H_3Cl\cdot O \end{array}$, the former in each case being the more probable one.

These substances are not affected by the usual reducing agents, but form additive compounds with hydriodic acid and acetic anhydride which are easily decomposed by alkalis, the original compounds being regenerated.

A strong aqueous solution of the diazonium salt from dichlorobenzidine, when heated with twice its volume of concentrated sulphuric acid, yields a very small quantity of 4:4′-dihydroxy-3:3′-dichlorodiphenyl (m. p. 124°); dianisidine does not give rise to a similar product.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next ordinary Meeting, on **Wednesday**, May 20th, at **5.30.** p.m., the following papers will be communicated:

"Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl-neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_3$." By G. Tattersall and F. S. Kipping.

"The conditions of decomposition of ammonium nitrite." By V. H. Veley.

"The action of liquefied ammonia on chromic chloride." By W. R. Lang and C. M. Carson.

"Note on the action of methylamine on chromic chloride." B W. R. Lang and E. H. Jolliffe.

"Cholesterol. A preliminary note." By R. H. Pickard and J. Yates.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/5/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 267.

Wednesday, May 20th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Mr. Francis Watts was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Colin Noel Bennett, 95, High Street, Camden Town, N.W.
William Hunter Gandy, Bradley Court, Mitcheldean, Gloucester.
John Howard Linday, Fenton Hall, Great Fenton, Stoke-on-Trent.
Arthur Moore, 83, Elgin Road, Seven Kings, Essex.
Thomas Rhind, M.R.C.S., 69, Gloucester Road, Regent's Park.
Charles J. Smith, "Sunnydale," Walton New Road, Stockton Heath.
Sidney H. Woolhouse, M.A., 2, Durham Road, Lower Edmonton, N.

THE DALTON CENTENARY.

The PRESIDENT stated that, in company with Sir Henry Roscoe and Dr. T. E. Thorpe, Past-Presidents, Professor Frankland, Vice-President, Dr. Scott, Senior Secretary, and Sir William Ramsay, Foreign Secretary, delegates appointed by the Council, he had taken part in the celebration by the Literary and Philosophical Society of Manchester of the centenary of the enunciation of the Atomic Theory by John Dalton, and in the name of the Chemical Society had presented the following address:

THE CHEMICAL SOCIETY

TO THE

LITERARY AND PHILOSOPHICAL SOCIETY OF MANCHESTER.

GREETING.

Recognising the Atomic Theory as having been the foundation of scientific chemistry, the Chemical Society desires to be associated with the Literary and Philosophical Society of Manchester in celebrating the centenary of its enunciation by

JOHN DALTON.

The century which has elapsed since the recognition of the great generalisations which led to the establishment of the theory has afforded continuous proof of its importance throughout the whole domain of physical science, and especially of chemistry, every new development of which has served to consolidate its position.

The Chemical Society offers at the same time to the Literary and Philosophical Society, so much older than itself, an expression of hearty congratulations on having been the medium of the first publication of that theory to the world, and having for upwards of a century so honorably assisted in promoting scientific, literary, and philosophical inquiry, more especially in those early days before the time of Dalton, when the physical sciences were still unorganised and waiting for the firm and philosophical basis on which they now rest.

Signed on behalf of the Chemical Society,

WILLIAM A. TILDEN, *President.*
HORACE T. BROWN, *Treasurer.*
ALEXANDER SCOTT } *Secretaries.*
W. PALMER WYNNE }
WILLIAM RAMSAY, *Foreign Secretary.*

SEAL.

May 7th, 1903.

He reminded the Society that John Dalton was born in 1766, and was therefore a young man when, in 1803, he communicated to the

Literary and Philosophical Society a paper "On the Absorption of Gases by Water and other Liquids," to which is appended the first table of atomic weights. Dalton states in the preface to his "Chemical Philosophy," that a brief outline of his views and of the results of his experiments "was first publicly given in the ensuing winter in a course of lectures on natural philosophy at the Royal Institution in London." The first volume of the "Natural Philosophy," containing the well-known symbols of the atoms devised by Dalton, is dated 1808.

The President further announced that a bust of Dalton had been modelled with the aid of the Chantrey marble and various authentic portraits, one of which, a daguerreotype, is in the possession of the Society, and that the bust when finished would be offered to the Society, probably before the end of the session, by our Past-President, Dr. Thorpe.

CENTENARY OF THE BIRTH OF LIEBIG.

The President then stated that he had a further agreeable announcement to make.

The bust of Liebig which was placed on the table is a gift which the Society owes to the generosity of our Fellow, Dr. Messel.

It was probably not generally known that this year, and nearly at this time, is the hundredth anniversary of the birth of the famous German chemist. The day of the month is usually stated to be May 12th, and this is the date given in Hofmann's lecture, delivered before the Society in 1875, and is therefore probably correct. No time has therefore been lost in honouring this important event.

We in England should be among the first to acknowledge the debt which science and the world at large owes to Liebig. Sixty years ago, when at the height of his fame, he visited England, and although it is true that he found but little science in this country, he had many admirers here who assisted in promoting a knowledge of the principles of plant and animal physiology which had been so largely the product of his own researches. With the advance of time has come so much new knowledge that Liebig's teaching in connection with agriculture, physiology, and medicine seems now to be less influential than it was fifty years ago. We cannot, however, forget that his views represented at that time an immense stride in advance of the state of ignorance which previously prevailed. As chemists, we more especially recognise our indebtedness to Liebig not only as one of the chief founders of modern organic chemistry, but as having given us the system of practical instruction which, in principle, has been adopted in all universities and chemical schools since his time. Whether any of the students who worked under his direction in the laboratory at Giessen still survive is uncertain, but those who went forth as teachers certainly transmitted to succeeding generations something of the spirit which animated all those who came under Liebig's influence.

Of the following papers, those marked * were read:

*73. "The conditions of decomposition of ammonium nitrite." By V. H. Veley.

The decomposition of ammonium nitrite into nitrogen and water proceeds according to the general law, $\log A/A-x=a\theta$, whether the reaction follows its normal course or is accelerated by the addition of another substance. The decomposition is either impeded or stopped by ammonia liberated in the solution by the addition of a metallic oxide, this effect being likewise produced by aliphatic, benzenoid, and pyridine amines, also by aromatic hydrazines, and to a less degree by oximes; it is temporarily accelerated by amides of the aliphatic series, but other amides are ineffective. Benzoic sulphinide ("saccharin"), the only imide tried, produces a considerable acceleration, but the reaction proceeds according to the general law.

It does not appear that solutions of ammonium nitrite, prepared from silver nitrite and ammonium chloride, become alkaline in the course of the decomposition. Incidentally it was shown that finely-divided barium sulphate, although producing no permanent effect when added to a solution of ammonium nitrite evolving nitrogen, nevertheless temporarily increased the rate of evolution of nitrogen, owing to some alteration in the amount of dissolved gas.

DISCUSSION.

Dr. **DIVERS** thought from the results of the investigation by Dr. Haga and himself of the interaction of sulphurous and nitrous acids in presence of bases that it was free nitrous acid which, by its action on ammonium nitrite or ammonia, gave rise to the production of nitrogen.

Dr. **LAPWORTH** said that Dr. Veley's observations recalled the work of Hantzsch and Schümann, who had shown (*Ber.*, 1899, 32, 1691) that the velocity with which diazotisation of aromatic amines takes place is accelerated by an excess of acid. This change is not, as usually represented, a decomposition of the nitrite of the base, but is the effect of free nitrous acid on the substituted ammonium salt, or, in other words, the result of the interaction of the substituted ammonium ions with un-ionised nitrous acid.

Dr. VELEY agreed with Dr. Divers that the initial change in the decomposition of ammonium nitrite was the resolution of the salt into its constituent base and acid, as is also the case with ammonium nitrate. The nitrogen or nitrous oxide resulted from a subsequent interaction of the liberated ammonia with the nitrous or nitric acid respectively.

*74. "Freezing point curves for some binary mixtures of organic substances, chiefly phenols and amines." By J. C. Philip.

When the initial freezing points of a series of mixtures of two subtances are determined and these temperatures are plotted against concentration, a freezing point curve is obtained which, in the simplest case, consists of two branches, starting from the freezing points of the constituents and cutting each other at a eutectic point. If, however, the two substances can unite to form a compound, the two branches are cut by another intermediate curve, which may sometimes have a summit.

Examples of the latter type of curve with an intermediate branch have been found by the author for the system phenol—urea, where the summit occurs with a mixture containing 33 molecular per cent. of urea, and for the systems *p*-cresol—aniline, phenol—*a*-naphthylamine, phenol—*p*-toluidine, *a*-naphthol—*p*-toluidine, phenol—picric acid, in all of which cases the summit occurs when the compounds are in molecular proportion.

According to Roozeboom's theory, the summit of the intermediate branch is reached with a mixture corresponding in composition with the formula of the compound, and crystals of this compound separate from all mixtures falling within the limits of the intermediate branch. This view has been confirmed in the above cases by analysis of the crystals which separated when solidification began.

In the freezing point curve for phenol—urea, the intermediate branch is cut abruptly at the summit by another branch ending, apparently, at the freezing point of urea. Perhaps the most interesting freezing point curve obtained was that for phenol—*p*-toluidine, inasmuch as the compound formed by these two substances exists in two modifications with an intermediate branch on the freezing point curve corresponding with each variety. The compound of phenol and *a*-naphthylamine crystallises so slowly that it was found possible to realise considerable portions of the ordinary branches of the freezing point curve underneath the intermediate branch and below the eutectic temperatures.

The compounds of *p*-cresol and aniline (plates; f. p. 21°), phenol and *p*-toluidine (plates; f. p. 29°), α-naphthol and *p*-toluidine (needles; f. p. 53·5°), phenol and picric acid (bright yellow needles; f. p. 83°) have not been previously described.

DISCUSSION.

Dr. LOWRY referred to the melting point curves for mixtures of water with succinic and phthalic anhydrides recently plotted by van der Stadt (*Zeit. physikal. Chem.*, 1902, **41**, 353). In these cases, the "compound" (that is, the acid) is much more stable and less fusible than its components, so that these only separate from the fused product when this consists of almost pure water or pure anhydride; the central portion of the curve thus extends from about 0 up to 96 or 98 molecular per cent. of anhydride. Moreover, the extent to which the "compound" dissociates on fusion can be gauged from the form of the central portion of the curve; if there were no dissociation, this would consist of two intersecting lines, but if there is much dissociation the pointed crest becomes replaced by a rounded summit, and in extreme cases may even be reduced to a broad, flattened convexity.

Mr. CROMPTON inquired whether the author had ascertained to what extent his results were in agreement with the Schroeder-Le Chatelier formula.

Dr. DESCH referred to the interest which the author's results presented in connection with the study of metallic alloys, and inquired whether, in the cases examined, the descending and ascending branches of the freezing point curve were represented by straight lines. In the majority of alloys, these branches are more or less curved, indicating the formation of solid solutions, even if only to a limited extent.

Dr. PHILIP, in reply, said that the freezing point curve for the system, acid anhydride—water, which had an intermediate summit at a temperature far above the freezing points of the constituents, resembled those of the systems, mercury—sodium and α-naphthol—picric acid, studied by Kurnakoff and Kuriloff respectively.

He had not attempted to apply the Schroeder-Le Chatelier formula to his results, as the subject had been treated entirely from the experimental point of view.

The branches of the freezing point curve, starting from the freezing points of the components, although sometimes very nearly rectilinear, were, in the majority of cases, slightly concave to the concentration axis.

75. "Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl*-*neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_3$." By G. Tattersall and F. S. Kipping.

The β-methyl-α-hydrindamine, obtained by reducing methylhydrindoxime, has been separated into the two externally compensated bases of which it is composed by the use of *d*-bromocamphorsulphonic acid, which forms with each of the *dl*-bases a partially racemic salt. The externally compensated base, which is present in the larger quantity, is called *methylhydrindamine*, the other being termed neo-*methylhydrindamine.*

Methylhydrindamine bromocamphorsulphonate,

$$C_{10}H_{13}N,C_{10}H_{14}OBr\cdot SO_3H,H_2O,$$

crystallises from dilute alcohol in hydrated, rhomboidal prisms, and, when dehydrated, melts at 160—165°. In dilute aqueous solution, this salt has a specific rotation $[\alpha]_D = +51\cdot5°$, and a molecular rotation $[M]_D = +235\cdot5°$. These values are abnormal, because, since the salt contains *dl*-base, its molecular rotation should be that of the bromocamphorsulphonic acid, namely, $[M]_D = +270°$.

The *benzoyl* derivative of methylhydrindamine melts at 151°; the *hydrochloride*, *sulphate*, and *picrate* are also described.

neo-*Methylhydrindamine bromocamphorsulphonate,*

$$C_{10}H_{13}N,C_{10}H_{14}OBr\cdot SO_3H,$$

crystallises from alcohol in large, anhydrous, transparent prisms melting at 194°; its specific rotation in dilute aqueous solution is $[\alpha]_D = +58\cdot9°$, whence $[M]_D = +269\cdot5°$. This value is normal on the assumption that the salt is partially racemic, and this was proved to be the case.

The *benzoyl* derivative of *neo*-methylhydrindamine melts at 169°. The *hydrochloride*, *sulphate*, and *picrate* of the neo-base are also described.

dl-Methylhydrindamine bromocamphorsulphonate is not resolved by ordinary fractional crystallisation, but when treated with a mixture of warm alcohol and ethyl acetate a precipitate of the salt of the *l*-base is obtained, the salt of the *d*-base remaining in solution.

l-*Methylhydrindamine bromocamphorsulphonate* separates from water in long, anhydrous needles, the original melting point of which is 230°; its specific rotation in dilute aqueous solution is $[\alpha]_D = +45\cdot7°$, and molecular rotation $[M]_D = +209\cdot4°$. The free base is lævorotatory in dilute aqueous solution; its *hydrochloride*, which crystallises from water in needles or plates, has $[M]_D = +56°$.

d-*Methylhydrindamine bromocamphorsulphonate* is indistinguishable in appearance from the salt of the *l*-base; it has an original melting point of 249°; its specific rotation is $[\alpha]_D = +71°$, and molecular rotation $[M]_D = +326°$. The free base is dextrorotatory in aqueous alcoholic solution.

The formation of isomeric partially racemic salts of the same type as those formed from hydrindamine and *d*-bromocamphorsulphonic acid having been expected, and such isomerides not having been found in the original mixture of salts, the question of their existence was solved by decomposing each of the pure partially racemic salts and regenerating each separately from its components. Crystallisation of the products failed to reveal the presence of any isomerides, so that it is concluded that isomeric partially racemic α- and β-salts of methylhydrindamine and *neo*-methylhydrindamine do not exist.

Isomeric Salts of the Type $NR_1R_2H_3$.—On fractionally crystallising *l*-methylhydrindamine bromocamphorsulphonate, the melting point of the first fraction after about 20 crystallisations rose to 236°, thus indicating that the original salt is a mixture. The pure salt (m. p. 236°) was then decomposed and regenerated from the same base and the same acid; fractional crystallisation of this product gave deposits with melting points gradually falling from 236° to about 224°. The first and last fractions were found to differ also in specific rotation, the first fraction (α*l*) having $[\alpha]_D = +47°$, $[M]_D = +216°$, whilst the last gave $[\alpha]_D = +41°$, $[M]_D = +188°$. The existence of isomeric salts derived from *l*-methylhydrindamine and *d*-bromocamphorsulphonic acid is thus proved.

The isomeric salt melting at 236° is called the α*l*-salt; the second isomeride, which is named the β*l*-salt, could not be obtained in a pure condition.

The *d*-methylhydrindamine bromocamphorsulphonate obtained by the resolution of the partially racemic salt was treated in the same way as the salt of the *l*-base, and regenerated from its component acid and base; the product was fractionally crystallised. The specific rotations in dilute aqueous solution and the melting points of the first and last fractions were found to be as follows:

First fraction (α*d*). $[\alpha]_D = +73°$, $[M]_D = +334°$; m. p. 262°.
Last fraction ...... $[\alpha]_D = +67°$, $[M]_D = +307°$; m. p. about 240°.

Here, again, the existence of isomerides, distinguished as the α*d*- and β*d*-salts, is established, but the former only was obtained in a pure condition.

The original *l*- and *d*-components are, therefore, mixtures and consist of α*l*- and β*l*-, and α*d*- and β*d*-salts respectively. If equal quantities of each are mixed before systematic crystallisation, the original partially racemic salt is obtained. If, however, equal weights of the *al*- and *ad*-salts are mixed, a partially racemic salt, different from the original one, is obtained :

	M. p.	Crystalline form.	$[\alpha]_D$ in water.
Original partially racemic salt	160—165°	Rhomboidal prisms.	+51°.
Synthetical partially racemic salt...	206°	Rectangular prisms.	+60°.

The original partially racemic salt consists of the four components, namely, *al*-, *βl*-, *ad*-, and *βd*-salts, and corresponds with the partially racemic *β*-salt obtained from *dl*-hydrindamine and *d*-bromocamphorsulphonic acid.

76. "The action of liquefied ammonia on chromic chloride." By W. R. Lang and C. M. Carson.

When liquefied ammonia acts on violet chromic chloride, a salmon-coloured powder is produced, from which water extracts two distinct compounds, which are easily crystallisable *in vacuo* and correspond in composition with the formulæ $Cr_2Cl_6,12NH_3,2H_2O$ and $Cr_2Cl_6,10NH_3$. The former substance is yellow, whilst the latter has the colour of cobalt nitrate. The salmon-coloured powder, when kept at 15°, yields both yellow and red crystals, but if heated to 110° it gives the red substance only. These compounds are completely decomposed at 180°.

77. "Note on the action of methylamine on chromic chloride." By W. R. Lang and E. H. Jolliffe.

Methylamine acting on violet chromic chloride produces a pink powder very readily soluble in water, from which it can be crystallised with difficulty owing to the rapidity with which chromium hydroxide separates out. The composition of the crystals corresponds with the formula $Cr_2Cl_6,10CH_3 \cdot NH_2$. The pink compound, when heated at 100°, yields a substance containing 8 mols. of ammonia ; complete decomposition into chromic oxide occurs at 120°.

78. "Cholesterol. Preliminary note." By R. H. Pickard and J. Yates.

Owing to the recent publication of the *Habilitationschrift* (Freiburg) of A. Windaus bearing the above title, the authors wished to state that for over two years they have been investigating the constitution of cholesterol obtained from gallstones. The effects of nitric acid, fused potassium hydroxide, potassium chlorate and hydrochloric acid, and alkaline permanganate solution on cholesterol have been studied in turn. The results hitherto obtained show that the cholesterol is composed of a very stable, complex nucleus joined to a normal chain of some nineteen carbon atoms, inasmuch as arachidic acid, $C_{20}H_{40}O_2$, is one of the products of its oxidation. The hydrocarbons obtained when cholesterol is treated with dehydrating agents and the action of alkalis on the halogen derivatives of cholesterol are also being investigated.

79. "Hydrogen cyanide in fodder-plants." By J. C. Brünnich.

After the important discovery, by Messrs. Dunstan and Henry, of a glucoside "Dhurrin" (*Proc. Roy. Soc.*, 1902, **70**, 153) in the young plants of sorghum, which, on decomposition in presence of water, yields hydrogen cyanide, the author, on behalf of the Queensland Department of Agriculture, carried out a series of experiments in order to ascertain at what stages and conditions of growth the fodder-plants belonging to the sorghum family are most dangerous. Two varieties of sorghum, and also a variety of maize, were grown on unmanured and heavily manured plots and analysed at various stages. The results show that sorghums should never be used as fodder in very young and immature stages of growth.

80. "Sulphocampholenecarboxylic acid." By A. W. Harvey and A. Lapworth.

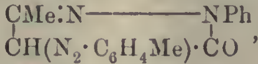
When sulphocampholenecarboxylic acid (*Proc.*, 1902, **18**, 142) is oxidised with potassium permanganate, no oxalic acid is formed, and the product consists almost entirely of acids which cannot be removed from a strongly acidified aqueous solution by ether, ethyl acetate, or acetone, and is therefore probably a mixture of sulphonic acids. A minute quantity of a volatile fatty acid, perhaps acetic acid, was detected. When the oxidation product is carefully fused with potassium hydroxide, it yields a mixture of carboxylic acids, the main constituent being identified as $\alpha\alpha$-dimethylglutaric acid.

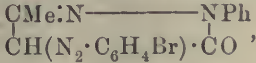
The *methyl* ester, $\mathrm{CO_2Me{\cdot}\underline{C_9H_{14}Br{\cdot}SO_2{\cdot}O}}$ (m. p. 192—193°), and the *ethyl* ester, $\mathrm{CO_2Et{\cdot}\underline{C_9H_{14}Br{\cdot}SO_2{\cdot}O}}$ (m. p. 101—102°), are very easily obtained from the sultonecarboxylic acid (*loc. cit.*) by Fischer's method. The carboxyl group is therefore attached to a hydrogenated carbon atom.

The above observations indicate (1) that in the formation of sulphocampholenecarboxylic acid from α-bromocamphor, scission has occurred between the carboxyl group and the trimethyl*cyclo*pentane nucleus,

(2) that the acid does not contain the group $:C:CH\cdot CO_2H$, but probably $\vdots C\cdot CH_2\cdot CO_2H$, (3) that it is most probably related to β- and not to α-campholenic acid in spite of its optical activity, which is perhaps due to the presence of the sulphonic group.

81. "Optically active esters of β-ketonic and β-aldehydic acids. Part III. Azo-derivatives of menthyl acetoacetate." By A. Lapworth.

Menthyl phenylazoacetoacetate, $C_6H_5\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, from menthyl acetoacetate and phenyldiazonium sulphate in presence of sodium acetate, forms large, transparent crystals melting at 76—77°. In a $1\frac{1}{2}$ per cent. solution in benzene, it has initially $[\alpha]_D = -21{\cdot}62°$, and this rises after some days to a constant value, $[\alpha]_D = -52{\cdot}52°$. The corresponding p-*tolylazo*-compound, $C_6H_4Me\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 86—87°, and in benzene has $[\alpha]_D = -11{\cdot}86°$ changing to $-61{\cdot}56°$; with phenylhydrazine, it yields p-*methylphenyl*-4-*azo*-1-*phenyl*-3-*methyl*-5-*pyrazolone*,  $\begin{matrix} CMe{:}N & \text{———————} & NPh \\ | & & | \\ CH(N_2\cdot C_6H_4Me)\cdot & & CO \end{matrix}$, which forms yellow or orange needles melting at 136—137°.

Menthyl p-*bromophenylazoacetoacetate*, $C_6H_4Br\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 119—121°, and, in benzene solution, has $[\alpha]_D = -12{\cdot}84°$ changing to $-46{\cdot}88°$; with phenylhydrazine, it gives rise to 4-*bromophenylazo*-1-*phenyl*-3-*methyl*-5-*pyrazolone*,  $\begin{matrix} CMe{:}N & \text{———————} & NPh \\ | & & | \\ CH(N_2\cdot C_6H_4Br)\cdot & & CO \end{matrix}$, which melts at 152—153°.

Menthyl p-*chlorophenylazoacetoacetate*, $C_6H_4Cl\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 103—105°, and in benzene has $[\alpha]_D = -15{\cdot}43°$ changing to $-55{\cdot}79°$; with phenylhydrazine, it gives 4-p-*chlorophenylazo*-1-*phenyl*-3-*methyl*-5-*pyrazolone* melting at 141—142°.

The mutarotation of the above compounds is accelerated by traces of bases or acids. By the action of diazo-oxides on the esters, formazyl compounds are formed. The following have been isolated, but the colour of their solutions is too intense to admit of the determination of their rotatory power.

Menthyl pp′-*dimethylphenylformazylcarboxylate*,

$$C_6H_4Me\cdot NH\cdot N{:}C(N_2C_6H_4Me)\cdot CO_2\cdot C_{10}H_{19},$$

forms dark red crystals with a blue reflex and melts at 134—136°; *menthyl* p-*bromophenyl*-p′-*methylphenylformazylcarboxylate* melts at 149—151°; *menthyl* p-*chlorophenyl*-p′-*methylphenylformazylcarboxylate* melts at 145—147°.

The mutarotation of the azo-derivatives of menthyl acetoacetate is due to *iso*dynamic change in virtue of the lability of the α-hydrogen atom, and when this hydrogen atom is replaced by bromine the specific rotation becomes invariable. The α-bromo-derivatives, which represent a new class of azo-compounds, were made (1) by direct bromination of the above esters, (2) by the interaction of a diazo-oxide and menthyl α-bromoacetoacetate.

Menthyl phenylazo-α-bromoacetoacetate, $C_6H_5 \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19}$, forms large, yellow crystals melting at 133—134°; it has $[\alpha]_D = -82 \cdot 45°$ in benzene. The corresponding p-*tolylazo*-compound, $C_6H_4Me \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19}$, melts at 155—156° and has $[\alpha]_D = -85 \cdot 95°$. The p-*bromophenylazo*-compound,

$$C_6H_4Br \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19},$$

melts at 155° and has $[\alpha]_D = -73 \cdot 45°$; the p-*chlorophenylazo*-compound melts at 147—148°; it has $[\alpha]_D = -67 \cdot 61°$. The crystals of these four compounds exhibit anomalous dispersion of the optic axes.

The following note has been received since the meeting:

82. "The chemical reactions involved in the rusting of iron." By W. R. Dunstan.

In a lecture delivered before the Royal Artillery Institution at Woolwich, the substance of which was published in the *Proceedings* of that Institution (Vol. 26, 1899, No. 5) and also in *Engineering*, June 1, 1900, the author gave a general account of the results of an investigation of the chemical process of rusting. This investigation, which was conducted with the cooperation of Dr. Jowett, was afterwards continued, and with the assistance of Mr. E. Goulding extended, especially to the atmospheric corrosion of iron and steel, and a further account of the results obtained was published in the Report (1900) of the Steel Rails Committee of the Board of Trade, of which the author was a member. Since then, the inquiry has been further extended, especially with reference to the atmospheric corrosion of pairs of metals and to the elucidation of the general process. Various circumstances have, however, delayed the completion of the work, and the present summary of the results is published pending the preparation of a fuller account of the investigation.

It has been proved that whilst both liquid water and oxygen are necessary for the formation of rust, the presence of carbonic acid is not essential, although it may accelerate the action. The well-known effect of alkalis and alkaline salts in preventing the oxidation of iron has been hitherto attributed to the withdrawal of the carbonic acid. It has been found, however, that the phenomenon is not due to this cause, but to the establishment of conditions in which the production of hydrogen peroxide is inhibited.

When highly purified iron, containing mere traces of impurity, is left in contact with dry gases (oxygen, carbon dioxide, mixtures of oxygen and carbon dioxide), rusting does not take place. In the presence of the same gases and water vapour, no rusting occurs so long as a constant temperature (34° in the actual experiments) is maintained, but if the temperature is allowed to fluctuate, liquid water condenses on the surface of the iron and rust is produced. It is thus shown that pure iron is not oxidised in presence of gases and water-vapour only, but that the presence of liquid water is necessary for rusting to take place.

In another series of experiments, pieces of iron were left in contact with water saturated with a particular gas and with an atmosphere of the same gas above the solution. When hydrogen, carbon dioxide, or nitrogen which had been carefully freed from oxygen was employed, rusting did not occur, but if oxygen or a mixture of oxygen and carbon dioxide was used, oxidation took place. From these results, it is evident that for the formation of rust both oxygen and liquid water are required. In the experiments in which a mixture of oxygen and carbon dioxide was used, the results observed indicated that in this case a secondary action proceeds simultaneously.

In order to investigate the influence of solutions of various salts on the production of rust, small pieces of highly purified sheet iron were enclosed with the different solutions in sealed glass tubes, the space above the solution in each case being filled with pure oxygen. The following substances were found to prevent to a greater or less extent the formation of rust : sodium carbonate, ammonium carbonate, borax, disodium hydrogen phosphate, calcium hydroxide, ammonia, potassium dichromate, potassium ferrocyanide, chromic acid, sodium nitrite, and potassium carbonate. Rusting occurred in the presence of the following compounds : sodium chloride, potassium chlorate, ferrous sulphate, potassium ferricyanide, potassium nitrate, and sodium sulphate. The reagents which prevent the rusting of iron are those in presence of which decomposition of hydrogen peroxide takes place and which are consequently inimical to its formation. There can be little doubt, therefore, that hydrogen peroxide plays an important part in the chemical process of rusting. By the direct action of hydrogen peroxide on metallic iron, a red basic ferric hydroxide, identical with ordinary rust, is rapidly produced, and it is found that in general those metals rust in air which are oxidised by hydrogen peroxide, whilst those metals which are not oxidised by hydrogen peroxide do not rust in air. Iron, zinc, and lead are examples of the first class, and the rusting of all these metals is stopped by contact with substances which prevent the formation of hydrogen peroxide. Copper, silver, and nickel are examples of the second class; these metals do not rust in air and are not oxidised by hydrogen peroxide.

The analysis of a number of specimens of iron rust has shown that its composition may be represented by the formula $Fe_2O_2(OH)_2$.

The chemical reactions concerned in the process of rusting may therefore be represented by the following equations: $Fe + O_2 + H_2O = FeO + H_2O_2$. $2FeO + H_2O_2 = Fe_2O_2(OH)_2$.

The presence of water in the liquid state is essential alike for the occurrence of rusting and for the formation of hydrogen peroxide.

In the case of certain metals, notably that of zinc, hydrogen peroxide can be detected during the process of rusting. It has not been possible, however, to detect with certainty the presence of hydrogen peroxide during the rusting of iron. This may be due to the fact, previously mentioned, that iron is very rapidly oxidised by hydrogen peroxide with formation of rust, so that under ordinary conditions the hydrogen peroxide is quickly destroyed.

The influence of certain other reactions on the process of rusting has been studied and may be summarised as follows:

(I) The direct decomposition of water by metallic iron with liberation of hydrogen can take place only at a relatively high temperature and is not affected by the presence of alkaline salts, such as sodium carbonate.

(II) The action of aqueous carbonic acid on iron in the absence of oxygen results in the liberation of hydrogen and formation of ferrous carbonate or bicarbonate. If oxygen is present, the ferrous salt subsequently undergoes oxidation, the rust obtained in this case containing a varying amount of carbonate.

(III) Electrolytic action occurs when the iron is impure or when another metal is present. The electropositive metal suffers oxidation and hydrogen gas is evolved. This action is not prevented by the presence of sodium carbonate.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Hartley, H. B. Polymorphism. pp. 29. From the Author.

Frankland. Autobiographical sketches from the life of Sir Edward Frankland, K.C.B., F.R.S. pp. 480.
From Mrs. West and Mrs. Colenso.

II. *By Purchase.*

Georgievics, G. von. Chemistry of dyestuffs, translated from the second German edition by Charles Salter. pp. 402. London 1903.

Klöcker, Alb. Fermentation organisms. A laboratory hand-book. Translated from the German by G. E. Allan and J. H. Millar, and revised by the author. pp. 392. ill. London 1903.

International Catalogue of Scientific Literature. First Annual Issue. C. Physics, Part II ; G. Mineralogy, including petrology and crystallography, 2 vols. London 1903.

Richter, V. von. Chemie der Kohlenstoffverbindungen oder organische Chemie. Zehnte Auflage. Bearbeitet von R. Anschutz in Gemeinschaft mit G. Schrœter. Vol. I. *Die Chemie der Fettkorper.* pp. 746. ill. Bonn 1903.

Wolfrum, A. Chemisches Praktikum. Teil II. Präparative und fabrikatorische Übungen. pp. 575. ill. Mit einem Atlas. Leipzig 1903.

—— Die Grundzüge der chemischen Didaktik. Eine Studie über das Studium Chemie und den Laboratoriumsunterricht. pp. 147. Leipzig 1903.

III. *Pamphlets.*

Betti, Mario. Benaftossazine e composti affini contenenti radicali aldeidici e chetonici misti (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

—— Sulla funzione delle basi β-naftol-aldaminiche. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

—— Reazione generale di condensazione fra β-naftolo, aldeidi e amine. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

Clemm, W. N. Die Gallensteinkrankheit, ihre Häufigkeit, ihre Entstehung, Verhütung und Heilung durch innere Behandlung. Berlin 1903.

Garland. La industria del petróleo en el Perú en 1901. (*Being Boletin del Cuerpo de Ingenieros de Minas del Peru No.* 2.)

Hall, A. D. The continuous growth of mangels for twenty-seven years on the same land, Barn Field, Rothamsted. (*From the Journ. of the Royal Agricultural Society of England*, vol. 63, 1902.)

Langworthy, C. F. The functions and uses of foods. (*Being U.S. Dept. of Agric. Office of Experiment Stations Circular* 46.)

National Physical Laboratory. Reports for years 1901–2.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next ordinary Meeting, on **Thursday**, June 4th, 1903, at **8** p.m., the following papers will be communicated:

"Imino-ethers corresponding to ortho-substituted benzenoid amines." By G. D. Lander and F. T. Jewson.

"Formation of an anhydride of camphoryloxime." By T. M. Lowry.

"The mutarotation of glucose as influenced by acids, bases, and salts." By T. M. Lowry.

"The solubility of dynamic isomerides." By T. M. Lowry.

"Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_3$." By F. S. Kipping.

"Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

"The hydrolysis of ethyl mandelate by the fat splitting enzyme, lipase." By H. D. Dakin.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 268.

Thursday, June 4th, 1903. Dr. W. H. PERKIN, F.R.S., Vice-President, in the Chair.

Certificates were read for the first time in favour of Messrs. :

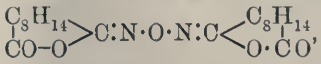
Ernest Derwent, 36, Sixth and Railroad, Ironton, Ohio, U.S.A.
William Forster, 6, North Railway Street, Seaham Harbour.
Edwin Reginald Hughes, 106, Queen Victoria Street, London, E.C.
Walter Ernest Jennings, 8, Rawdon Terrace, Ashby de la Zouch.
William Parry, B.Sc., 23, Mount Pleasant, Waterloo, Liverpool.

The following certificate was authorised by Council under Bye-Law I (3).

Wilfrid William Ogilvy Beveridge, A.M.S. Laboratory, Pretoria.

Of the following papers, those marked * were read:

*83. "Formation of an anhydride of camphoryloxime." By T. M. Lowry.

When nitrocamphor is boiled with concentrated hydrochloric acid, the greater part of the substance passes into solution and is converted into camphoryloxime. During the investigation of this isomeric change (*Trans.*, 1898, 73, 1002), a considerable quantity of a resinous by-product was accumulated; this substance has now been examined and found to contain an *anhydride*,  $\begin{matrix}C_8H_{14}\\ |\\ CO{-}O\end{matrix}{>}C{:}N{\cdot}O{\cdot}N{:}C{<}\begin{matrix}C_8H_{14}\\ |\\ O{\cdot}CO\end{matrix}$, of *camphoryloxime,* which, after crystallisation from alcohol, softens at about 215°, melts at 220°, and has $[\alpha]_D = +26°$ in acetone.

*84. "Mutarotation of glucose as influenced by acids, bases and salts." By T. M. Lowry.

Both acids and bases have an accelerating effect on the mutarotation of glucose, whilst potassium chloride is without influence. If the mutarotation is conditioned by the presence in the glucose of an exceedingly minute quantity of basic impurity or a somewhat larger amount of acid impurity, a retardation should be produced when the base or acid is neutralised by adding hydrogen chloride or potassium hydroxide respectively. Careful quantitative experiments showed that this retardation does not occur, and the conclusion is drawn that although the mutarotation is accelerated by both acids and bases, its occurrence is independent of the presence of these impurities. Probably the water alone is sufficient to condition the change if enough impurity is present to render it an electrolyte.

*85. "The solubility of dynamic isomerides." By T. M. Lowry.

Whilst the rotatory power affords a general method for studying the dynamic isomerism of optically active substances, no similar method is available in the case of inactive bodies. The measurements of electrical conductivity, so effectively employed by Hantzsch in the study of pseudo-acids, pseudo-salts, and pseudo-bases, can only be made when one of the isomerides is an electrolyte and at least moderately soluble in water. Of the other physical properties, density, molecular solution volume, refractive index, dispersion, and magnetic rotatory power differ relatively little in isomeric compounds, and the melting point, colour and ultra-violet absorption cannot easily be made the basis of quantitative measurements. The solubility of dynamic isomerides is, however, usually very different, and under certain conditions it is possible to follow experimentally the gradual change of solubility as a substance is converted into a dynamic isomeride. This method, which has been devised and tested in the case of optically active substances, will, it is believed, be of service in the study of inactive bodies, and thus render possible the quantitative examination of many changes that have hitherto been examined only qualitatively.

If the less soluble isomeride is initially in contact with the solvent, the solubility gradually increases until the liquid phase contains a normal proportion of the two forms. If, however, the more soluble isomeride is used, the solubility increases until the liquid is saturated with both forms; the solution then contains a much greater proportion of the more soluble isomeride and isomeric change proceeds continuously, the more soluble modification dissolving whilst the less soluble form separates from the solution; finally, when the whole of the more soluble form has dissolved, the solubility decreases to a constant value identical with that obtained when the less soluble isomeride alone is used.

Measurements of the solubility of pseudo-β-bromonitrocamphor in benzene show that at 10° the solubility gradually increases from 2·3 to 9·3 grams per 100 grams of benzene, whilst when both forms are present in the solid phase the solution contains nearly 14 per cent. of the substances.

*86. "The rusting of iron." By G. T. Moody.

The contention of Dunstan (*Proceedings of the Royal Artillery Institution*, 1899, No. 5, 26; this vol. p. 150) that carbon dioxide is not essentially concerned in the process of rusting and that this change is caused by hydrogen peroxide is based on the observation that solutions of chromium trioxide, potassium dichromate, potassium ferrocyanide, sodium nitrite and other substances which decompose hydrogen peroxide, entirely or nearly entirely prevent rusting. The author finds that the retarding action exercised by these substances is due to the influence they exert on the absorption of carbon dioxide. For example, when exposed to the gas under exactly the same conditions, water absorbed 90·6 volumes, whilst a 15 per cent. solution of chromium trioxide and a 20 per cent. solution of sodium nitrite absorbed 4·2 volumes and 5·6 volumes respectively. A solution of chromium trioxide—which itself does not attack iron—appears all the more to exert a protecting influence because of the ease with which it dissolves ferric oxide. Iron, when placed under a 1 per cent. solution of chromium trioxide exposed to air, remains bright for some weeks, although the metal is slowly passing into solution. Eventually rust commences to form on the metal, although the solution still contains free chromic acid.

When iron is exposed to water and oxygen previously freed as far as possible from carbon dioxide, the volume of oxygen remains practically unchanged. On admitting carbon dioxide, the volume of oxygen diminishes rapidly and rusting becomes visible.

The interaction of iron with aqueous carbonic acid appears to be strictly comparable with that occurring between iron and sulphuric acid. A solution of carbonic acid, formed by saturating 2·4 litres of water at 18° with carbon dioxide, when left in contact with 500 grams of clean iron turnings yielded 635 c.c. of hydrogen in 7 days. After remaining for one week, the solution contained 0·1 per cent. of iron present as ferrous bicarbonate, a substance which is readily decomposed by atmospheric oxygen yielding a mixture of ferrous carbonate and ferric oxide, whilst a part of the carbonic acid is regenerated. On account of the ease with which this change takes place, it follows that in presence of oxygen a definite weight of carbonic acid will exert a greater corroding influence on iron than will its equivalent of sulphuric or hydrochloric acid.

The author contends that the primary action in rusting involves the interaction of iron and acid and that rust is formed by the subsequent oxidation of ferrous salt.

DISCUSSION.

Mr. C. E. GROVES said it was known that iron immersed in potassium carbonate solution did not rust, and asked whether the author had examined the action on iron of a solution of *potassium* hydrogen carbonate saturated with carbon dioxide. He believed it was not generally known that solid caustic potash containing about 5 per cent. of water, when fused at a gentle heat in contact with steel, readily attacked it, the iron apparently forming a ferrous compound. Fused caustic soda, however, had practically no action on iron.

Dr. JOWETT said that, having cooperated with Professor Dunstan in the work to which Dr. Moody had referred, he must point out that much of the criticism seemed to be based on a misunderstanding. The rusting of iron was the sum of several chemical reactions each of which had been separately studied. It was not stated or thought that the oxidation in which hydrogen peroxide might take part constituted the whole phenomenon of rusting, and one of the experiments shown by Dr. Moody, namely, the evolution of hydrogen from a mixture of aqueous carbonic acid and iron, was referred to in Professor Dunstan's note. The oxidation in which it was suggested that hydrogen peroxide was involved, occurred when oxygen, water, and pure iron were used, and it was a fact that substances which decomposed hydrogen peroxide prevented oxidation under conditions similar to those in which the peroxide was produced during the oxidation of zinc.

Finally, although the analyses of rust produced under ordinary atmospheric conditions generally showed the presence of carbon dioxide, they agreed closely with the formula $Fe_2O_2(OH)_2$, which was also found to represent the composition of the product formed by the oxidation of iron under the conditions previously mentioned.

Dr. SCOTT asked if the chromic acid was free from sulphuric and nitric acids.

He mentioned that Dr. Russell's experiments on the action of various metals on photographic plates showed that zinc very readily gave hydrogen peroxide and even mercury containing 1/300th per cent. of zinc produced sufficient to affect a photographic plate.

Dr. KOHN asked whether any experiments had been tried on the influence of light on the action of carbonic acid, since many changes effected by air and moisture and attributed to the formation of hydrogen peroxide did not occur or were diminished in absence of light. Such experiments might indicate whether hydrogen peroxide had any contributory action.

Mr. A. C. CHAPMAN asked whether Dr. Moody had assured himself that the amount of hydrogen evolved in the experiment referred to was not greater than that which would correspond with the carbon dioxide present, and also whether he had made any experiments as to the influence of the purity of the iron employed on the quantity of gas evolved. In other words, was the hydrogen solely the result of replacement, or might not some of it have been produced by electrolytic action pure and simple.

Dr. HENRY pointed out that in the course of the experiments referred to in Prof. Dunstan's note, a specimen of pure sheet iron with bright surfaces had been immersed for more than six years in a 4 per cent. aqueous solution of chromic acid contained in a loosely stoppered jar; during the whole of that time the surfaces had remained perfectly bright and there was no evidence of either the reduction of the chromic acid or the formation of iron rust, although the solution was in contact with atmospheric carbon dioxide. He suggested that the rusting observed by the author when iron was kept in solutions of dilute chromic acid in presence of carbon dioxide might be due to the employment either of commercial iron or chromic acid containing impurities; it was known that the presence of neutral salts such as sodium chloride in water in which iron was immersed accelerated the rate of rusting.

Dr. LOWRY said that if hydrogen peroxide were a product of the initial stage in the rusting of iron, its destruction by chromic acid might be expected to assist rather than retard the oxidation.

Dr. MOODY, in reply, said that in discussing this subject it was necessary to be agreed as to what was meant by rusting. He understood rusting to mean the corrosion taking place when metals were left exposed to air under ordinary conditions. Water condensed from air contains carbonic acid, which in contact with iron immediately gives rise to a ferrous salt. Since ferrous salts equally with chromic acid, sodium nitrate, and potassium ferrocyanide establish a condition in which the production of hydrogen peroxide is inhibited, it follows that the theory advanced by Dunstan can have no bearing on the atmospheric rusting of iron.

87. "Imino-ethers corresponding with ortho-substituted benzenoid amides." By G. D. Lander and F. T. Jewson.

Pinner's method of synthesis of imino-ethers fails either partially or completely with aryl cyanides containing an *ortho*-substituent, and one of the authors has shown that the main product of the action of ethyl iodide and dry silver oxide on *o*-toluamide in boiling alcoholic solution is a nitrile (*Trans.*, 1901, 77, 695).

When boiling alcohol is employed as a medium, the alkylation of other amides by this method seems to be characterised by the formation of nitriles, but whilst the yield of imino-ether from *o*-toluamide is only 13·6 per cent., the proportion is 70 per cent. in the case of *p*-toluamide; this result is explained by supposing that the *o*-compound more readily loses alcohol than its *p*-isomeride, $C_7H_7{\cdot}C{:}NH{\cdot}OEt = C_7H_7{\cdot}CN + EtOH$. The same constitutive factor, however, renders the *o*-imino-ether more stable as regards hydrolysis by aqueous hydrochloric acid, $C_7H_7C{:}NH{\cdot}OEt + H_2O + HCl = C_7H_7{\cdot}CO_2Et + NH_4Cl$.

Although better yields of the imino-ether are obtained when the synthesis is carried out in boiling ethereal solution, yet in this case, nitrile is also produced.

The *hydrochloride* of *o*-chlorobenziminoethyl ether decomposes at 105°, yielding *o*-chlorobenzamide; the *methyl* analogue forms a *hydrochloride* which decomposes at about 110°. o-*Chlorobenzmethylamide* is also a product of the methylation of *o*-chlorobenzamide, and forms colourless needles melting at 92—94°. o-*Toluiminomethyl ether* was prepared by the action of methyl iodide on the silver derivative of *o*-toluamide; its *hydrochloride* decomposes between 110° and 115°.

o-*Toluiminoethyl ether*, when mixed with nitrile, distils without change between 106° and 118° under 20—25 mm. pressure, and yields a *hydrochloride* which decomposes at 105—106°.

88. "The hydrolysis of ethyl mandelate by lipase." By H. D. Dakin.

Optical isomerides are frequently very differently affected by enzymes as well as by living organisms, but the production of an optically active substance from inactive material as the result of simple enzyme action has not hitherto been conclusively demonstrated.

If the conception of an enzyme as an optically active asymmetric complex is correct, and, morever, if combination occurred between the enzyme and the substance acted on, it should be possible to show that when an enzyme acts on an optically inactive substance, the two optical components are decomposed with unequal velocity.

This was shown to be the case when inactive ethyl mandelate was hydrolysed by the enzyme lipase. In all cases, provided hydrolysis was incomplete, the separated mandelic acid was found to be strongly dextrorotatory whilst the unchanged ester was lævorotatory.

The reaction would appear to bear a close analogy to the hydrolysis of esters prepared from an optically active alcohol and an inactive acid (Marckwald and McKenzie, *Ber.*, 1901, **34**, 469).

89. "Isomeric change in benzene derivatives. The conditions influencing the interchange of halogen and hydroxyl in benzenediazonium hydroxides." By K. J. P. Orton.

The supposed *s*-tribromophenylnitrosoamine, obtained by Hantzsch and Pohl (*Ber.*, 1902, **35**, 2964) from *s*-tribromobenzenediazonium acetate under conditions which, according to the author's earlier investigations (*Proc. Roy. Soc.*, 1903, **71**, 153), are favourable to the replacement by hydroxyl of the bromine atom in the ortho-position relatively to the diazo-group, is now shown, by an exact repetition of Hantzsch and Pohl's experiments, to consist of a mixture of 3 : 5-dibromo-*o*-quinonediazide (3 : 5-dibromo-*o*-diazophenol) and an amorphous condensation product, probably a hydroxyazo-derivative, either when prepared from the diazonium salt or from the corresponding alkali diazo-oxide (diazotate). Moreover, the hydrochloride obtained by Hantzsch and Pohl by passing hydrogen chloride into an ethereal solution of the original yellow material and thought by them to be the hydrochloride of the nitrosoamine, is, in fact, the hydrochloride of the quinonediazide, which can readily be prepared from it by hydrolysis with water.

The transformation of the diazonium acetates derived from 2 : 4 : 6-tribromo-3-nitroaniline, 2 : 3 : 4 : 6-tetrabromoaniline, 3 : 5-dibromo-*p*-toluidine, 2 : 6-dibromoaniline, 2 : 4-dichloroaniline, and 2 : 4-dibromo-5-nitroaniline have been examined. When a nitro-group is in the meta-position relatively to the diazo-group, the replacement of the *o*- or *p*-bromine atom by hydroxyl takes place very readily, the diazo-compound in this respect resembling the naphthalene derivatives (*Proc.*, 1902, **18**, 252). It is remarkable that 3 : 5-dibromo-*p*-toluenediazonium acetate does not lose bromine.

2 : 6-Dibromobenzenediazonium acetate slowly undergoes this change, but chlorine ions are scarcely appreciable in a solution of 2 : 4-dichlorobenzenediazonium acetate, even after several days. Bromine is, however, rapidly displaced when a nitro-group is in the meta-position relatively to the diazo-group, as in the 2 : 4-dibromo-5-nitrobenzene diazo-compounds.

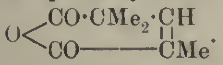
This interchange takes plaçe not only with the diazonium acetates and hydrogen carbonates, but also in a similar manner with the salts of other weak acids, such as the cyanides and the nitrites, but with these salts, however, other reactions occur simultaneously, thus 2 : 4 : 6-tribromo-1-nitrobenzene is also formed from the nitrite.

When the diazonium salt is present as sulphate, the change is extremely slow at the ordinary temperature, but at 80° nearly one atomic proportion of bromine is eliminated in four hours, a fact which no doubt accounts for the apparent impossibility of obtaining *s*-tribromophenol by heating aqueous solutions of *s*-tribromobenzenediazonium salts.

The following substances were described : 2 : 4 : 6-*tribromobenzeneazo-β-naphthol*, melting at 173—174° ; 3 : 5-*dibromophenol-2-azo-β-naphthol*, copper-coloured plates melting at 214—215° ; 3 : 5-*dibromo-2-nitro*-p-*quinonediazide* (3 : 5-*dibromo-2-nitro*-p-*diazophenol*), prepared from 2 : 4 : 6-tribromo-3-nitroaniline, crystallises in yellow plates decomposing at 196° ; *tribromoquinonediazide* (*tribromodiazophenol*), prepared from 2 : 3 : 4 : 6-tetrabromoaniline, forms orange crystals melting and decomposing at 124° ; 3-*bromo*-o-*quinonediazide* (3-*bromo*-o-*diazophenol*), prepared from 2 : 6-dibromoaniline, crystallises in orange needles melting and decomposing at 103° ; 2 : 4-*dichlorobenzeneazo-β-naphthol*, scarlet prisms melting at 190° ; *chlorophenolazo-β-naphthol*, minute needles melting at 265° ; 3 : 5-*dibromo*-p-*tolueneazo-β-naphthol*, scarlet prisms melting at 141°.

90. "The synthesis of ααγ-trimethylglutaric acid, of the *cis*- and *trans*-modifications of β-hydroxy-ααγ-trimethylglutaric acid, and of ααγ-trimethylglutaconic acid." By W. H. Perkin, jun., and Alice E. Smith.

A mixture of ethyl dimethylmalonate and ethyl acetate is readily acted on by sodium, yielding the sodium compound of ethyl αα-dimethylacetonedicarboxylate, $CO_2Et\cdot CMe_2\cdot CO\cdot CHNa\cdot CO_2Et$, and if this is treated with methyl iodide, *ethyl ααγ-trimethylacetonedicarboxylate*, $CO_2Et\cdot CMe_2\cdot CO\cdot CHMe\cdot CO_2Et$, is produced as a nearly colourless oil boiling at 195—197° under 100 mm. pressure, which, in alcoholic solution, gives a violet coloration with ferric chloride. When this ester is reduced with sodium amalgam, it yields a mixture of the *cis*- and *trans*-modifications of *β-hydroxy-ααγ-trimethylglutaric acid*, $CO_2H\cdot CMe_2\cdot CH(OH)\cdot CHMe\cdot CO_2H$. The *trans*-acid melts at 155° and when rapidly heated under reduced pressure distils with very little decomposition. The *cis*-acid melts at 115° and on distillation yields a crystalline substance, $C_8H_{10}O_3$, which melts at 88° and is probably the anhydride of cis-*ααγ-trimethylglutaconic acid*,

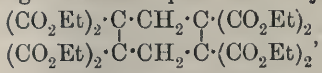
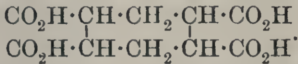


$$O\left\langle\begin{array}{l}CO\cdot CMe_2\cdot CH\\ \qquad\qquad\quad\ \|\\ CO\text{———}CMe\end{array}\right..$$

Both the *cis*- and *trans*-modifications of the hydroxy-acid, when treated successively with phosphorus pentachloride and diethylaniline, or when digested with fuming hydriodic acid, are converted into trans-*ααγ-trimethylglutaconic acid*; this acid, which melts at 150° and, when heated in small quantities, volatilises to a certain extent without decomposition, is reduced with difficulty, but by the action of a large excess of alcohol and sodium becomes converted into *ααγ-trimethylglutaric acid*, $CO_2H\cdot CMe_2\cdot CH_2\cdot CHMe\cdot CO_2H$, melting at 98°. When subjected to the action of dry bromine vapour, *trans*-ααγ-trimethylglutaconic acid is converted into *βγ-dibromo-ααγ-trimethylglutaric acid*, which crystallises from formic acid and melts at 205—207°.

91. "Hexamethyleneoctocarboxylic acid and the *cis*- and *trans*-modifications of hexamethylenetetracarboxylic acid (hexahydropyromellitic acid)." By T. W. D. Gregory and W. H. Perkin, jun.

When ethyl propanetetracarboxylate, $(CO_2Et)_2CH\cdot CH_2\cdot CH(CO_2Et)_2$, is treated with bromine, it yields *ethyl dibromopropanetetracarboxylate*, $(CO_2Et)_2CBr\cdot CH_2\cdot CBr(CO_2Et)_2$, which melts at 55°.

This bromo-ester reacts with the disodium compound of ethyl propanetetracarboxylate giving an almost quantitative yield of *ethyl hexamethyleneoctocarboxylate*,  $\begin{array}{l}(CO_2Et)_2\cdot C\cdot CH_2\cdot C\cdot(CO_2Et)_2 \\ \quad\quad\quad\;\; | \quad\quad\quad\; | \\ (CO_2Et)_2\cdot C\cdot CH_2\cdot C\cdot(CO_2Et)_2\end{array}$, a colourless, crystalline substance (m. p. 46°), which, when digested with hydrochloric acid, yields the free *hexamethyleneoctocarboxylic acid*; this substance decomposes at 218°, giving rise to the *cis*- and *trans*-modifications of *hexamethylenetetracarboxylic acid*,  $\begin{array}{l}CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO_2H \\ \quad\quad\quad\; | \quad\quad\quad\;\; | \\ CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO_2H\end{array}$. The *cis*-acid melts at 140°, and its *anhydride* at 60°; the *trans*-acid melts at 175°, and yields the latter compound on digestion with acetic anhydride and subsequent distillation.

92. "The bases contained in Scottish shale oil. Part II." By F. C. Garrett and J. A. Smythe.

The only bases obtained in a state of purity from the fractions of Scottish shale oil boiling between 164° and 180° are 2 : 3-*dimethylpyridine* and 2 : 4 : 6-trimethylpyridine. The lower homologue, which has not been described, is a liquid lighter than, and insoluble in, water, having a pleasant aromatic smell and boiling at 163—164° under 768 mm. pressure. Its mercurichloride melts at 120° and its aurichloride at 96°; its platinichloride melts and decomposes at 216°. The trimethylpyridine boils at 171° under 768 mm. pressure and gives an aurichloride containing one molecule of water of crystallisation and melting at 53°; when anhydrous, the salt melts at 112°.

93. "A direct method for determining the latent heat of evaporation." By J. Campbell Brown.

The latent heats of thirteen alcohols, seven acids, and twenty-eight esters have been directly determined by means of an apparatus adapted for ascertaining the weight of liquid evaporated by a determinate amount of heat applied at the boiling point of the substance, when this is surrounded by a double jacket containing its own vapour.

94. "Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_8$." By F. S. Kipping.

The isomeric partially racemic α- and β-salts obtained from *dl*-hydrindamine and *d*-chlorocamphorsulphonic acid (*Trans.*, 1900, 77, 889) are not resolved into their components under conditions similar to those employed in the resolution of the corresponding bromo-salts (*Proc.*, 1902, **18**, 209), but the four isomeric salts of the type $NR_1R_2H_3$, from which the partially racemic compounds are formed, have been isolated and examined.

d-Hydrindamine, prepared from the pure *αd*-bromo-salt (previously denoted *α*A-salt, *Proc.*, *loc. cit.*), combines with *d*-chlorocamphorsulphonic acid giving rise to two isomeric salts, one of which is formed in relatively very small quantities. The principal product, which corresponds with the *αd*-bromo-salt and is distinguished as the *αd*-isomeride, is easily obtained in a pure condition; it separates from water in well-defined, compact, hydrated crystals, melts at 208—209°, and has a specific rotation $[\alpha]_D = +46°$ in aqueous and $+15·5°$ in chloroform solution. It differs greatly in outward properties from the corresponding *αd*-salt of the bromo-acid, and also from all the other three isomeric chloro-salts.

The second product, which corresponds with the *βd*-bromo-salt (previously denoted *β*A-salt), is only obtained in a pure condition after a long course of fractional crystallisations; it separates from water in long, hydrated needles, melts at 202—203°, and its specific rotation in aqueous solution is $[\alpha]_D = +59°$, the value in chloroform being $[\alpha]_D = +50°$.

The great difference between these isomerides is very noteworthy considering the fact that the corresponding bromocamphorsulphonates of hydrindamine and of methylhydrindamine (Tattersall and Kipping, this vol., p. 145) are so similar that the *βd*-isomeride cannot be obtained in a pure state.

The pure *αd*-hydrindamine chlorocamphorsulphonate, decomposed with barium hydroxide solution, gives both the *αd*- and the *βd*-isomerides when regenerated from its component acid and base, a proof that these two salts are formed from structurally and optically identical components.

l-Hydrindamine, prepared from the pure *αl*-modification (previously denoted *α*B) of the bromo-salt, also combines with *d*-chlorocamphorsulphonic acid giving rise to a mixture of very unequal quantities of two isomeric salts. The principal product, the *αl*-modification, corresponding with the *αl*-bromo-salt, separates from water in long, anhydrous needles, indistinguishable in appearance from those of the *αl*-bromo-compound; it melts at 118—119° and has a specific rotation $[\alpha]_D = +44°$ in aqueous and $+45·5°$ in chloroform solution. The subsidiary product, namely, the *βl*-isomeride (formerly denoted *β*B), is only separated in a pure condition with very great difficulty; it crystallises from water in long, anhydrous needles which generally melt at about 140—145°, the indefinite melting point being apparently due to dimorphism, as in the case of the corresponding bromo-isomeride. Its specific rotation is $[\alpha]_D = +57.5°$ in aqueous and $+60.5°$ in chloroform solution.

When the pure *αl*-chloro-salt is decomposed with barium hydroxide solution and then regenerated from its own acid and its own base, a mixture of the *αl*- and *βl*-isomerides is obtained, just as from the original *l*-base.

It is to be noted that the *βd*- and *βl*-chloro-salts have a much *higher* molecular rotation than that of *d*-chlorocamphorsulphonic acid, whereas in the case of the corresponding bromo-salts the position is reversed; it follows, therefore, that the formation of these isomerides cannot be attributed to any partial racemisation of the acid or the base.

The isolation of these four isomeric hydrindamine *d*-chlorocamphorsulphonates seems to afford the final proof that the author's explanation of the existence of the partially racemic *α*- and *β*-salts is the true one (*Trans., loc. cit.*).

95. "Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

The isolation of the four isomeric hydrindamine *d*-chlorocamphorsulphonates (see previous abstract), the proof of the existence of four isomeric methylhydrindamine bromocamphorsulphonates (derived from one *dl*-base) (Tattersall and Kipping, this vol., 145), and other evidence fully confirm the author's views as to the nature of the isomeric partially racemic salts which have been previously studied (Kipping, *Trans.*, 1900, **77**, 861; 1901, **79**, 430), and establish the occurrence of isomerism in compounds of the type $NR_1R_2H_3$ (*Proc.*, 1902, **18**, 211).

The stability of the isomeric salts in aqueous solution leads to the conclusion that there are two different ions NR_1H_3- for each optically active base, and, consequently, it should be possible to transfer such ions from one acid to another without altering the configurations particular to them. Experiments bear out this conclusion. The partially racemic *β*-salt of hydrindamine and *d*-bromocamphorsulphonic acid is not converted into the corresponding *α*-salt when it is repeatedly evaporated first with concentrated hydrochloric acid and then with water, or when it is successively treated in aqueous solution with sodium carbonate and hydrochloric acid, the solution being then evaporated. The four basic ions of the *β*-salt can thus be transferred from the bromo-acid to hydrochloric or to carbonic acid, and back again to the bromo-acid without altering their relative proportions as long as the base is never in the free state.

The platinichlorides, prepared from the *ad*-, *al*-, and *βl*-modifications [previously called the αA-, αB-, and βB-modifications respectively (*Proc.*, 1902, **18**, 209)] of hydrindamine *d*-bromocamphorsulphonate by precipitating in presence of hydrochloric acid, seem to be identical in outward properties, and the hydrochlorides obtained from the platinichlorides by decomposing with hydrogen sulphide are also indistinguishable in appearance and in melting point; it would seem, nevertheless, that each of the optically active hydrindamines gives rise to two different hydrochlorides (indistinguishable in ordinary properties), firstly, because of the behaviour of the partially racemic *β*-salt (see above), and, secondly, because the *βl*-modification of hydrindamine *d*-chlorocamphorsulphonate can be converted into a hydrochloride from which the original *βl*-salt is obtained on evaporating with the chloro-acid.

The hydrochloride, prepared from the above-mentioned *βl*-bromo-salt, gave with ammonium *d*-bromocamphorsulphonate what appeared to be the pure *βl*-isomeride, but on repeating the experiment under different conditions, starting from the *βl*-chloro-salt, the *al*-modification was obtained: further investigation is necessary before this difference in behaviour can be explained, but it seems reasonable to conclude that *four isomeric hydrochlorides* of hydrindamine are capable of existence.

The molecular rotations of the *ad*- and *al*-salts in dilute aqueous solution are in all cases practically normal, but the *βd*- and *βl*-hydrindamine bromocamphorsulphonates give values which are far too low, whereas the *βd*- and *βl*-hydrindamine chlorocamphorsulphonates give numbers which are far too high; molecular weight determinations in boiling aqueous solution seem to indicate that the salts of the *β*-series are not so highly dissociated as the corresponding α-salts, but the evidence is very inconclusive.

The existence of isomeric salts of the type $NR_1R_2H_3$ can be accounted for by assuming that the five valencies of the nitrogen atom are directed from the centre to the angles of a square-based pyramid, but in view of the highly conflicting experimental evidence bearing on the question of the configuration of the nitrogen atom, this subject cannot yet be profitably discussed; even in the case of trivalent nitrogen, there is great uncertainty, as no case is yet known of isomerides of the type $NR_1R_2R_3$, although the existence of such compounds is a probable, if not a necessary, consequence of the hypothesis of Hantzsch and Werner.

ADDITIONS TO THE LIBRARY.

III. *Pamphlets.*

Schiff, Ugo. Separazione delle funzioni basica ed acida per mezzo della formaldeide. (*From the Gazz. Chim. Ital.*, **33**, pt. I, 1903.)

Speroni, C. Di alcuni derivati aldeidici del solfito di anilina. (*From the Gazz. Chim. Ital.*, **33**, pt. I, 1903.)

Van Slyke, L. L. Some facts about commercial fertilizers in New York State. (*Being Bull. No.* 230, *New York Agric. Exper. Station*, 1903.)

Van Slyke, L. L., and E. B. Hart. The relation of carbon dioxide to proteolysis in the ripening of cheddar cheese. (*Being Bull. No.* 231, *New York Agric. Exper. Station*, 1903.)

Voelcker, J. A., and A. D. Hall. The valuation of unexhausted manures obtained by the consumption of foods by stock.

Wiley, H. W. Manufacture of table syrups from sugar cane. (*Being U.S. Dept. of Agric. Bureau of Chemistry, Bull. No.* 53.)

At the next meeting, on **Wednesday**, June 17th, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials." By T. E. Thorpe.

"The estimation of arsenic in fuel." By T. E. Thorpe.

"Crystallised ammonium sulphate and the position of ammonium in the alkali series." A. E. H. Tutton.

"Action of hydrogen on sodium." By A. Holt, jun.

"The action of halogens on compounds containing the carbonyl group." By A. Lapworth.

"Reactions involving the addition of hydrogen cyanide to carbon compounds." By A. Lapworth.

"The acetoacetic ester synthesis." By A. C. O. Hann and A. Lapworth.

"Rimu resin." By T. H. Easterfield and B. C. Aston

"Note on the Karaka fruit." By T. H. Easterfield and B. C. Aston.

"The slow oxidation of methane at low temperatures. Part II." By W. A. Bone and R. V. Wheeler.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, June 17th, 1903.

Aubrey, Henry James,
The Cross, Worcester.

Analytical and Research Chemist. Member Pharmaceutical Society Gt. Britain. Certificated Society Apothecaries, London. Original work done on the treatment of hop yards for the destruction of blight, &c.

Herbert S. Shorthouse. Wallace C. Nickels.
W. S. Howie. Charles Bayliss.
Geo. E. Perry.

Barger, George,
50, Guilford Street, W.C.

Physiological chemist at the Wellcome Research Laboratories, Herne Hill, S.E. B.A. (Cantab.), B.Sc. (Lond.); late assistant at the Botanical Institute, Brussels University; engaged in physiological chemical research; published a paper in *Ber. d. deutsch. Chem. Gesellsch.*, 1902.

S. Ruhemann. W. J. Sell.
Charles T. Heycock. F. W. Dootson.
H. O. Jones.

Bennett, Colin Noel,
95, High Street, Camden Town, N.W.

Student Chemical Laboratory, University College, London. For the last 2½ years student at Chemical Laboratory, University College, London.

J. Norman Collie.
Edward C. Cyril Baly.
Morris W. Travers.
Alex. W. Bain.
S. E. Sheppard.
William Ramsay.

Bibby, Charles Drake,

69, Queens Road, Twickenham, Middlesex.

Chemist. Assistant in the Chemical Laboratory of Messrs. Burgoyne, Burbidges and Co., 1894 to 1899. Assistant Chemist in the Laboratories of the Pharmacie Centrale de France, Saint-Denis (Seine), 1899 to 1900. Student of Physiological Chemistry at King's College, London. At present Chemist in the Laboratory of Messrs. Parke, Davis and Co., Hounslow.

Thos. Farries.
Reginald G. Halstead.
Theophilus Pitt.
Georges Ponthieu.
Alf. J. Parker.

Brennand, Henry John Wolverton,

203, Macquarie Street, Sydney.

Medical Practitioner, employed as an Officer of the Government Statistician of New South Wales. Bachelor of Arts, Bachelor of Medicine, Master of Surgery, of the University of Sydney. (Honours in Chemistry.) At present engaged in the study of Physiological Chemistry. Formerly Teacher of Chemistry at Newington College, Sydney. Member of Royal Society of New South Wales.

A. Liversidge.
J. A. Schofield.
F. B. Guthrie.
Basil Turner.
William M. Hamlet.

Burghard, William Godsell,

180, High Holborn, W.C.

Student. Have studied Chemistry, Physics, Biology, Mathematics, and Geology since 1894 at the Birkbeck Literary and Scientific Institution and elsewhere. Hold Science and Art Department Certificates for Organic and Inorganic Chemistry. Now engaged in private chemical research work.

John E. Mackenzie.
J. Woodward.
H. F. C. Goltz.
Wm. W. S. Nicholls.
Edward Jones.

Bury, Ernest, M.Sc.

Brackley Coke Works, Little Hulton, near Bolton, Lancs.

Chemist to the Bridgewater Trustees, and Superintendent of the Brackley Coke Works. Student in the Chemical Department, Owens College, Manchester, 1891—1895. Graduated B.Sc. (Vict. Honours School of Chemistry) in 1895, and M.Sc. in 1899. Since 1895, he has filled the post of chemist to the Bridgewater Trustees, and is now in charge of their Brackley Bye-Product Coke Works at Little Hulton, near Bolton, Lancs.

W. H. Perkin, jun. Norman Smith.
Harold B. Dixon G. H. Bailey
J. F. Thorpe. William A. Bone.
D. L. Chapman.

Campbell, Thomas,

38, Eastbourne Street, Liverpool.

Science Master at St. Bede's Grammar School, Bradford. Winner of two open Science Scholarships (£35 per yr. for 2 years ; £65 per year for 3 years) at University Coll., Liverpool (Vict. Univ.), in which Chemistry was one of the subjects. Studied for one session under Dr. Tate at Liverpool School of Science (Chemistry). For 2 years was a student (Science) of University College, Liverpool. For 1 year was a student (Science) of Yorkshire College, Leeds (Victoria University). Have passed Inter. B.Sc. (Vict.) with Chemistry as one of the subjects. Have taught Chemistry (Theor. and Prac.) at above School since September last.

W. Ramshaw. George Tate.
Ernest Bowman Ludlam. *Geo. E. Welch.*
J. Campbell Brown. *W. Collingwood Williams.*
Wm. B. Davidson. *Robert C. Farmer.*

Carrier, Albert James,

30, Kingwood Road, Oldfield Park West, Bath.

Teaching. I have worked in the laboratories of the Bath City Analyst, of the Bath Technical Schools, and of the Bristol Merchant Venturers' College, passing from the last named the Board of Education examinations in Theoret. and Pract. Chem. (Honours, Part. II), and also the B.Sc. exam. of the London University with 1st Class Honours in Chem. Since Sept. 1901, lecturer at the Bristol Merchant Venturers' College

J. Wertheimer. Arnold Philip.
G. P. Darnell-Smith. Albert E. Thomas.
John E. Mackenzie.

Fairhall, Edwin Jesse,
29, Winsham Grove, London, S.W.

Analytical and research chemist in works. Four years at Central Technical College, South Kensington.

Henry E. Armstrong. T. M. Lowry.
William A. Davis. Edward W. Lewis.
A. J. Cownley.

Gandy, William Hunter,
Bradley Court, Mitcheldean, Gloucester.

Principal of Farm and Colonial School. Have passed London Int. B. Science examination in Chemistry, &c. Lecturer in Chemistry, both Agricultural and General, at Wellington Hall Agricultural School from 1895—1900. Lecturer in Chemistry at Norfolk Military College, Overstrand, Cromer, from 1900—1902. I have classes in Chemistry here.

R. Bodmer. *Fred. J. Lloyd.*
Basil Wm. Valentin *Bernard Dyer.*
J. A. Basker. *W. P. Skertchly.*
Alfred C. Chapman.

Harmer, Francis Gerald,
14, Tivoli Place, Ilkley. Address for Letters, &c., Middle Class School, Leeds.

Schoolmaster (Secondary School and School of Science—Headmaster). Headmaster of School of Science. Teacher of Chemistry (in above), Leeds, 8 years, and also in London for 4 years. Lecturer in Evening Science and Art Classes in London 4 years.

Arthur Smithells. Wm. A. Knight.
W. Ludford Freeman. W. B. Hards.
Thomas Hartley.

King, Frank William George,
15, Almond Road, Lower Tottenham, N.

Chemist to the "Veda Food Company," Edinburgh. Studied Chemistry under Dr. J. T. Hewitt for 2 years. Junior Assistant to Dr. Bernard Dyer 1½ years. Assistant to J. Heron, Esq., 2 years.

Bernard Dyer. J. F. H. Gilbard.
John Heron. J. T. Hewitt.
Frank E. King.

Levy, Henry Wolff,

Christian & Levy, 423B, Chancery Lane, Melbourne.

Assayer, Metallurgist, and Chemical Analyst, and member of the above firm, has studied Chemistry for four years under the tuition of Messrs A. H. Jackson, B.Sc., F.C.S., M.I.E.E., &c. David Avery, M.Sc., Heber Green, M.Sc., &c., and has spent some two years studying in the Laboratory and working on Messrs. Jaques Bros. Metallurgical Plant, Richmond. He is one of the Founders and Honorary Secretary of the newly-formed Institute of Analysts, Assayers, and Metallurgists, Victoria, and is at present engaged on research work in connection with titanium. As he is desirous of admission into the Chemical Society in order to receive their publications so as to keep in touch with Chemical Progress, we, the undersigned, propose and recommend him as a proper person to become a Fellow thereof.

Frederic Dunn. A. H. Jackson.
Robert Law. Francis R. Power.
Fred. W. Steel.

Linday, John Howard,

Fenton Hall, Gt. Fenton, Stoke-on-Trent.

Assistant Analytical Chemist. Studied at Ackworth School under Dr. Lean, and at Longton under Dr. Harris. For two years Assistant Analyst to the Stafford Coal and Iron Co. Am desirous to obtain the Chemical Literature of the Society.

Joseph West. Geo. W. Burman.
Walter Harris. Bevan Lean.
J. Howard Davidson.

Livesey, Charles Edwin Leonard,

23, Swinton Place, Gt. Horton, Bradford.

Science Teacher (Senior Science Master, St. Bede's Grammar School, Bradford). Degree of Bachelor of Science after 3 Years' Course at the Yorkshire College. Two Years' Science Teacher as above (Subjects: Chemistry and Physics).

Arthur Smithells. H. M. Dawson.
Julius B. Cohen. W. Lowson.
Henry R. Procter.

Mann, John Christopher,

9, Lambert Street, Hull.

Manufacturing Chemist. Member Soc. Chem. Industry (since 1891). Fifteen years Analytical and Research Chemist at the Gas Light and Coke Co.'s Products Works, Beckton, E. At present and for past 5 years Chemist and Manager to Messrs. Major and Co., Ltd., Tar Distillers, &c., Hull,

John William Young.
Frank H. Leeds.
J. T. Hewitt.
L. J. de Whalley.
Rudolph Messel.

Moore, Alfred Ernest, B.A., B.Sc. (London),
St. John's College, Battersea, S.W.

Lecturer in above College on Mathematics and Physical Science. Fourteen years Lecturer in Chemistry, and for Seven years Senior Lecturer in Physical Science, a position held at present.

Edgar E. Horwill.
Frank E. Weston.
J. Bernard Coleman.
J. C. Crocker.
Frank Clowes.

Moore, Arthur,
83, Elgin Road, Seven Kings, Essex.

Student of Chemistry, both Organic and Inorganic, 5 years at City of London College, Moorfields. Holder of several certificates in Chemistry, Board of Education. Anxious to possess the Chemical Society's Journal.

Isaac S. Scarf.
Jos. S. Bridges.
Chas. A. West.
Harold W. Harrie.
Thos. Tyrer.

Norman, George Marshall,
5, Watford Villas, Battersea Park, S.W.

Student Demonstrator. Associate of Royal College of Science and of Institute of Chemistry and Bachelor of Science, London Univ.

William A. Tilden.
H. Burrows.
M. O. Forster.
Chapman Jones.
G. T. Morgan.
James C. Philip.

Parry, George Harry,
The Level, Brierley Hill, Staffs.

Head Chemist, Earl of Dudley, Level New Furnaces, Brierley Hill. Educated at Stourbridge Grammar School, where took Chemistry; afterwards studied under W. Whitehouse, Esq., Wolverhampton, and F. Thompson, Esq., F.C.S., Dudley; with H. Silvester, Esq., F.C.S., F.I.C., Borough Analyst, West Bromwich, Do., Do., Dudley, first as pupil, afterwards chief assistant 3 years. I am now Head Chemist to

The Rt. Hon. The Earl of Dudley, Level New Furnaces, Brierley Hill, and have been so ten years.

Harry Silvester. Robt. D. Connell.
W. H. Pearson. *A. E. McKenzie.*
James E. Ferguson.

Purcell, Charles Stanley,

37, Acomb St., Greenheys, Manchester.

Assistant Chemist. A Student for three years in the Brewing Depart. of the School of Technology, Manchester. Has obtained the Honours Certificate of City and Guilds in Brewing. Honours in Chemistry of Board of Education. Assistant Chemist to Messrs. Robertson and Sons, Manchester.

William J. Pope. L. G. Radcliffe.
Jas. Grant. F. S. Sinnatt.
S. J. Peachey. J. Hübner.

Rhind, Thomas,

69, Gloucester Road, Regent's Park, London, N.W.

Medical Practitioner. Member of Royal College of Surgeons, Eng. Licentiate of Royal College of Physicians, London. Studying Sanitary Science and Chemistry.

R. E. S. Richardson. H. N. B. Richardson.
Lewis Ough. Henry Kenwood.
John Attfield.

Smith, Charles Joseph,

Sunnydale, Walton New Road, Stockton Heath.

Brewer. Chemist at Messrs. Peter Walker and Son, Ltd., Warrington, Brewers. Member of Institute of Brewing. First class certificate for Brewing, Examination for which comprised Practical and Scientific Brewing and the Chemistry of Brewing; First class certificates for Practical and Theoretical Inorganic and Organic Chemistry. For five years a student under Mr. F. G. Ruddock, F.I.C., Soc. Pub. Analysts.

Jas. Grant. J. Rymer Young.
L. G. Radcliffe. *F. S. Sinnatt.*
S. J. Peachey.

Smith, James Cruickshank, B.Sc.,

57, Great Ormond Street, Russell Square, W.C.

Professional and business address, 20, Nassau Street, Mortimer Street, W. Technical Chemist (Member of the Society of Chemical Industry, Member of the Society of Arts). Formerly Chief Assistant

"Young" Laboratory of Technological Chemistry, Glasgow and West of Scotland Technical College. Afterwards Technical Chemist and Works Manager. Author of "The Manufacture of Paint" (Scott, Greenwood and Co., 1901); "Notes on the Technical Examination, Analysis, and Valuation of Oils and Lubricants" (Lewis, Jameson and Co., 1903), and of numerous Articles and Papers in Scientific and Trade Journals.

Edmund J. Mills. G. G. Henderson.
F. R. Japp. John B. Orr.
William Maitland.

Tyrrell, Dennis,

182, King Street, Norwich.

Chemist and Brewer. Chemist and Brewer for Messrs. Youngs, Crawshay and Youngs, Ltd., Crown Brewery, Norwich. I have also attended classes in connection with S.K. for Chemistry, Organic and Inorganic (Theor. and Prac.), under S. Hewitt, F.C.S., and R. S. Cahill, F.C.S., and am desirous of keeping in touch with the latest progress in Chemical Science.

Francis Sutton. R. S. Cahill.
S. Hewitt. *Philip G. G. Moon.*
Alfred C. Young. *A. Peacock.*
C. E. Womersley.

Van Laer, Norbert,

69, Calais Road, Burton-on-Trent.

Brewer and Chemist to Messrs. Truman, Hanbury, Buxton, & Co., Ltd. For three years a student at the Technical School and Municipal Laboratories of the City of Ghent, Belgium. Also three years' Scientific training at the Professional School of Brewing of Ghent, and a Graduate of the same.

C. O'Sullivan. Chas. Geo. Matthews.
Jas. O'Sullivan. A. L. Stern.
George Harrow. Adrian J. Brown.

Woolhouse, Sidney Herbert,

2, Durham Rd., Lr. Edmonton, London, N.

Science Master, Parmiter's School, Victoria Park, London, N.E. (Teacher since 1889). M.A., B.Sc., Assoc. Royal College of Science, Dublin.

W. N. Hartley. William A. Tilden.
W. E. Adeney. Morris W. Travers.
Hugh Ramage.

The following was authorised by the Council under Bye-Law I. (3):

Beveridge, Wilfrid William Ogilvy,
A.M.S. Laboratory, Pretoria, S.A.

Major Royal Army Medical Corps. In charge of A.M.S. Laboratories for Transvaal, Orange River Colony, and Cape Colony. Written various reports for the Army on Food Stuffs, Disinfectants, etc.

Walter C. C. Pakes.	Alex. Crum Brown.
William J. Pope.	Leonard Dobbin.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 1/7/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 269.

Wednesday, June 17th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. E. S. Beaven and C. Rawson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Percy W. Gent, 792½, Ridge Street, Newark, N.J., U.S.A.
Henry William Lawrence, Wellington, New Zealand.
Herbert Stanley Redfern, B.Sc., Ningpo, China.
Frank Gurney Smith, 7, Luxemburg Gardens, Brook Green, W.

The PRESIDENT gave notice that an EXTRAORDINARY GENERAL MEETING will be held in the Society's Rooms on **Thursday, July 2nd, 1903, at 6 p.m.**, to consider the proposal of the Council to make certain alterations in Bye-law I., and in Circulars Nos. 2, 3, and 4 in the Appendix. The proposed changes are:—

I. To alter Bye-law I., page 13, lines 3 and 4, by *deleting* the words "one year."

The Bye-law at present reads :—

> "..... ; and he shall"
> "be entitled, so long as his annual subscription be not one"
> "year in arrear, to one copy of the annual publications of"
> "the Society. ....."

II. To alter the Circulars in the Appendix as follows :—

In Appendix, No. 2, "Letter notifying the Election of a Member," 5th and 6th lines, p. 26, *delete* the words "the Assistant Secretary." After the words "before admission.*" *add* the words "Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in."

" No. 3, "Annual Circular Letter of Treasurer," *delete* from "If paid" to end of circular, and *substitute* the same words as added in No. 2.

" No. 4, "Annual Circular Letter of Treasurer to Fellows who are two years in arrear of their Subscriptions," *delete* from "Payments should be made" to end of circular, and *substitute* the same words as added in No. 2.

PRESENTATION OF THE LONGSTAFF MEDAL.

THE PRESIDENT spoke as follows: We have so recently celebrated the Centenary of the Atomic Theory that it is a matter of interest to notice that, in the award of the Longstaff Medal on the present occasion, we honour the practical fulfilment of the deductions from that great conception. Dalton himself represented in his diagrams atoms of solid bodies like ice arranged with reference to the crystalline form of the solid, but for three-quarters of a century successive writers could merely speculate as to their possible order in space of three dimensions. The discoveries of Pasteur in connection with hemihedrism in crystals, and the study of the lactic acids by Wislicenus, prepared the way for the development of the theory of stereochemistry by Van't Hoff and le Bel in 1874. But while that theory has prospered and has led to innumerable developments in the study of the compounds of carbon, and although it must have been always obvious that if the idea of a tetrahedral configuration was valid for compounds of one element a corresponding idea should be equally applicable to those of others, the demonstration of the facts upon which such a development must rest has only been accomplished within the last four years.

To Professor William Jackson Pope the Council has awarded the Longstaff Medal, by a unanimous vote, for his researches on the stereochemistry of compounds of elements other than carbon. In 1893, Professors Kipping and Pope prepared the *d*-bromo- and *d*-chlorocamphorsulphonic acids, and by the use of these and other powerful optically-active acids, Mr. Pope has succeeded, not only in resolving into their active components certain racemic bases which had been found irresolvable by the use of tartaric acid, but in 1899, by the use of *d*-camphorsulphonic acid, he separated the dextro- and lævo-modifications of a synthetical tetralkylammonium base, and thus definitely established the existence of asymmetric optically active nitrogen compounds.

Since that time, by similar methods, he has obtained the dextrorotatory methyl ethyl thetine, a dextrorotatory tin compound, and both forms of a selenetine, thus demonstrating the fact that the elements nitrogen, sulphur, tin, and selenium are each capable, like carbon, of producing asymmetric combinations possessing optical activity. We therefore now possess direct experimental evidence in regard to the compounds of carbon, tin, sulphur, and selenium, as tetrad elements and of nitrogen as a pentad, so that it may confidently be expected that not only will the phosphorus series of elements be found capable of producing pairs of enantiomorphous compounds, but, possibly, similar modifications of oxonium bases may be discovered, and some of the metals, such as platinum, cobalt, and chromium, may be found to exhibit similar phenomena. The doctrine of valency, no less than the doctrine of atoms, in its application to all ordinary terrestrial chemical phenomena, is thus triumphantly established.

Professor Pope, it gives me great pleasure to be the medium of communicating to you the congratulations of the Council, and in handing you the Longstaff Medal I express the feelings of the whole chemical world when I say that we trust you will have health, and strength, and time to continue the researches which have already yielded such a rich harvest of splendid results.

Professor Pope, in expressing his sense of the honour done him by the award of the Longstaff Medal, desired to acknowledge gratefully the assistance which the Research Fund Committee had given to his work; it would be difficult to over-estimate the extent to which the Research Fund of the Chemical Society has contributed to the encouragement of chemical investigation in Great Britain. He wished also to record his indebtedness to his old friend and teacher, Dr. H. E. Armstrong, who first taught him to look upon our science as a living and growing branch of knowledge, and inspired him with a desire to contribute something towards its development.

Dr. G. B. Longstaff, in expressing his great pleasure at being present on this occasion, said that the researches for which Professor Pope had been awarded the medal considerably advanced our conceptions of the atomic theory in so far as they broke down some of the apparent barriers between carbon and the other elements. He recalled the fact that his father, who had been a friend of Dalton's, was not only a Fellow of this Society from its commencement, but also the founder of Chemical Societies in Edinburgh and Glasgow, and was, moreover, instrumental in placing on a working basis the Research Fund (first suggested by Dr. Miller) to which Professor Pope had referred. Nevertheless, the name of the donor of the medal would have remained obscure except for the reflected light thrown on it, as it were, by the great names of an already long succession of eminent medallists.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Henry James Aubrey.
George Barger, B.A., B.Sc.
Colin Noel Bennett.
Wilfrid W. O. Beveridge.
Charles Drake Bibby.
Henry J. W. Brennand, B.A., M.B.
William Godsell Burghard.
Ernest Bury, M.Sc.
Thomas Campbell.
Albert James Carrier, B.Sc.
Edwin Jesse Fairhall.
William Hunter Gandy.
Francis Gerald Harmer.
Frank William George King.
Henry Wolff Levy.
John Howard Linday.
Charles Edwin L. Livesey, B.Sc.
John Christopher Mann.
Alfred Ernest Moore, B.A., B.Sc.
Arthur Moore.
George Marshall Norman, B.Sc.
George Harry Parry.
Charles Stanley Purcell.
Thomas Rhind, M.R.C.S.
Charles Joseph Smith.
James Cruickshank Smith, B.Sc.
Dennis Tyrrell.
Norbert Van Laer.
Sidney H. Woolhouse, M.A., B Sc.

Of the following papers, those marked * were read:

*96. "The estimation of arsenic in fuel." By T. E. Thorpe.

An account was given of a method of estimating the amount of arsenic in fuels which is accurate, fairly rapid in execution, and which has the additional merit of directly distinguishing between the arsenic which is volatilised on burning the fuel and that which remains fixed in the ash. The process consists simply in burning a known quantity of the finely powdered coke or coal in a stream of oxygen, passing the products of combustion through a suitable absorbing apparatus, and determining the amount of arsenic so absorbed as well as that left in the ash.

The estimation of the arsenic in the solutions may be made by means of the Marsh apparatus and comparison with standard deposits of arsenic, or preferably with the electrolytic method described in the subsequent communication. The accuracy of the method was tested by burning fuels containing known quantities of arsenic, added in the form of arsenical pyrites.

*97. "The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials." By T. E. Thorpe.

An electrolytic method for detecting arsenic appears to have been first suggested by the late Professor Bloxam (*Quart. Journ. Chem. Soc.*, 1861, **13**, 12 and 338), but in its original form it had several disadvantages which have prevented it from being generally adopted by chemists. The process has been carefully investigated in the Government Laboratory, and in the form described in the present communication it is easy of application, and is capable of giving trustworthy results with a comparatively small expenditure of time and trouble.

The test may be applied to malt and malt substitutes, wort, hops and hop substitutes, beer, yeast and yeast foods, finings, &c.

The advantages of the electrolytic method are :—

1. That it obviates the use of zinc.

2. It is simple in execution, is under perfect control, and may be carried out under such conditions that the results obtained by different operators are strictly comparable, inasmuch as with a current-strength of fair regularity the evolution of the gas is practically constant and uniform.

3. The whole of the solution to be tested for arsenic may be added to the apparatus at once, so that during the whole time of testing the arsenic is under the influence of the "nascent" hydrogen.

4. It has been established that such amounts of arsenic as are present in beer or its ingredients are evolved as hydrogen arsenide during the 30 minutes occupied by the test. The nature of the material associated with the arsenic is found to exercise no inhibiting effect on the formation and evolution of the hydrogen arsenide. Aqueous extracts of malts and worts may be added directly to the electrolytic apparatus without previous destruction of the organic matter as required by the zinc and acid process.

5. The deposits obtained are more uniform in character than those furnished by the zinc and acid method, and admit therefore of more accurate quantitative comparison.

6. The process allows of the simultaneous execution of a number of estimations of arsenic, depending upon the arrangement of the rheostat.

The disadvantages of the method are:—

1. The initial cost of the apparatus as compared with that employed in the zinc and acid method.

2. That it can only be applied when an electric current of sufficient intensity is available.

Discussion.

Dr. Thorne said the electrolytic process would prove of the greatest value to the large number of chemists who had to test for very small quantities of arsenic. The Marsh-Berzelius process was very reliable and accurate, and had been rightly recommended by the Committee of the Societies of Chemical Industry and Public Analysts, but those who used it knew the difficulty of obtaining zinc and hydrochloric acid free from arsenic, and hence these reagents must be carefully purified if the test was to be satisfactorily carried out. In the process just shown, these difficulties were obviated. He had had the opportunity of seeing the method in operation, and could therefore speak as to its satisfactory working.

Mr. Arthur R. Ling also thought that the electrolytic process would doubtless prove much more convenient than the Marsh-Berzelius method, which, in the case of many materials, necessitated the destruction of organic matter.

In the set of standards exhibited, the mirrors obtained in the presence of glucose appeared to be less intense than those produced in the absence of organic matter, from the same weight of arsenic, by the Marsh-Berzelius method.

Mr. William Thomson believed that the electrolytic method suggested by Lord Kelvin and the ingenious apparatus devised by Dr. Thorpe and his colleagues may ultimately afford the most practicable means of detecting arsenic in beer and food-stuffs.

He had tested one of the appliances, and had found that it would not detect the presence of more than about 1/350th of a grain of As_4O_6 per gallon, whilst the zinc and acid method easily detects 1/1000th of a grain per gallon when using 50 c.c. of the solution. Assuming at first that this difference was due to an insufficient surface of cathode, he used a much larger area of platinum wire gauze, but obtained the same results with regard to the size of mirrors as those obtained in Dr. Thorpe's apparatus.

Platinum seems to retain minute quantities of arsenic, but when a pure zinc cathode is employed the 1/1000th part of a grain per gallon can easily be detected when using 50 c.c. of the solution.

He could confirm Dr. Thorpe's observations that minute quantities of arsenic in the form of pentoxide cannot be detected by the electrolytic method, 1/200th of a grain per gallon (using 50 c.c.) yielded no mirror at all with the platinum anode, and gave an approximately half-sized mirror with the zinc anode.

In other respects, his results differed from those obtained by Dr. Thorpe. He found that both amyl alcohol and sugar seriously reduced the size of the mirrors, and he was of opinion that it is unsatisfactory to test beer directly in Dr. Thorpe's apparatus.

Dr. McGowan said that, together with Mr. R. B. Floris, he had during the past year examined a large number of samples of anthracite for arsenic. The method which, after some preliminary experiments, they had employed in this work was a modification of Newlands and Ling's basic process. Although the results obtained were very consistent, and, as they believed, accurate, yet this process had the disadvantage of being an indirect method with regard to the "volatile" arsenic present. Other things being equal, a direct method such as that now brought forward by Dr. Thorpe was preferable.

Dr. Thorpe, in reply to Mr. Ling, stated that he had not been able to perceive any difference in the intensity of the mirrors produced from a known quantity of arsenic in the electrolytic method as compared with the Marsh-Berzelius method. A comparison of the standards in the two cases, as shown on the table, would prove that there was no practical difference in the two series.

In reference to what fell from Mr. Thomson, he might say that attempts had been made to increase the activity of the cathode by depositing platinum black upon it, but nothing seemed to be gained thereby. Experience showed that the best and most uniform results were obtained by keeping the metallic surfaces as clean and bright as possible.

*98. "Crystallised ammonium sulphate and the position of ammonium in the alkali series" By A. E. H. Tutton.

The author has hitherto shown that the morphological and physical properties of the crystals of the normal sulphates and selenates of potassium, rubidium, and cæsium follow the order of progression of the atomic weights of the three alkali metals. An analogous study of normal ammonium sulphate indicates that this salt stands in the series of normal alkali sulphates between rubidium and cæsium sulphates, and very close to the rubidium salt, as regards the following nine properties:—solubility, molecular volume, distance ratios (topic axes), refractive indices, axial ratios of the optical ellipsoid, molecular refraction along axial directions, mean refraction equivalent both for the crystallised and the dissolved salt, and the general optical scheme which governs the optic axial angle phenomena. With respect to all these properties, the replacement of the two atoms of potassium by the ten atoms composing the two NH_4 groups is accompanied by an effect but slightly greater than when two atoms of rubidium are substituted for those of potassium.

The specifically different nature of the ammonium radicle as compared with a metallic atom of the alkali group asserts itself in regard to the morphological angles and axial ratios, the specific refraction, certain details of the distance ratios and the optic axial angle phenomena, and in the development of only one instead of two cleavages. Yet even in the case of the crystallographical angles, this difference is only manifested with regard to the direction of the change of angle on replacement, and as far as the amount of change is concerned the ammonium compound stands between the rubidium and cæsium salts, and somewhat nearer to the latter. It is indeed, surprising that the introduction of eight additional atoms should be accompanied by less change in the exterior angles of the crystals than when an exchange of cæsium for potassium atoms occurs.

In short the specific constants indicate the peculiar nature of the ammonium radicle, whilst the molecular constants show that ammonium occupies a place in the alkali series immediately after rubidium.

This result opens up questions of the arrangement of the atoms in the molecule and the closeness of the packing of the molecular structural units in the crystal edifice. It suggests that either the atoms have a range of motion inside the molecular dimensions sufficiently wide to admit eight more atoms without altering those dimensions to an appreciably greater extent than when the transposition of rubidium and potassium atoms is effected, or that the structural units are so loosely packed, that is, the amount of free space is so large as compared with the amount of matter in the whole space defined by the distance ratios, that there is adequate room for the increase of the material part of the molecule by eight atoms, without separating the centres of contiguous molecules more than when a simple metallic interchange occurs.

*99. "The action of hydrogen on sodium." By A. Holt, jun.

Pieces of sodium free from oil were placed in a nickel boat and heated in a combustion tube through which a slow current of pure dry hydrogen was passing. An ordinary small combustion furnace without top tiles was employed, and it was arranged so that, whilst the lower part of the tube was strongly heated, the upper portion was kept at a lower temperature in order that the hydride might condense on it. The hydride thus obtained consisted of colourless matted crystals, a hairy deposit not unlike cotton wool, and a white powder deposited next to the glass. The hairy material was formed on and above the powder in front of the boat, whilst the crystals projected from the surface of the tube at either side of the boat.

The analysis was performed (i) by decomposing the hydride with dry, air-free hydrogen chloride, collecting the hydrogen due to the reaction and estimating the sodium chloride formed by titration with silver nitrate; (ii) by decomposing the hydride with absolute alcohol, collecting the hydrogen evolved, and estimating the sodium in the alcoholic solution by titration with standard acid. The ratio of sodium to hydrogen showed that the hydride had the composition NaH, as already stated by Moissan.

The hydride was instantly decomposed by water, forming sodium hydroxide and hydrogen, this result also occurring in air after a few minutes; it was at once decomposed by hydrochloric acid, the decomposition being accompanied by flame and a detonation. The hydride was immediately attacked by nitric and sulphuric acids, hydrogen sulphide, and alcohol, but ether, benzene, and mercury were without action on it.

With phenol and ammonia, it reacts only when heated, forming sodium phenoxide and sodamide respectively.

Carbon dioxide, when perfectly dry, has no action on the hydride at the ordinary temperature, but on heating, a reaction takes place with the formation of carbon and a carbonate. The partially dried gas reacts with the hydride at the ordinary temperature, yielding a formate and carbon. When heated with ferric oxide, the hydride gives a ferrate.

The combination of hydrogen with sodium appears to take place only when the latter is in a state of vapour; the sodium probably interacts only when it is partially monatomic.

100. "The action of halogens on compounds containing the carbonyl group." By Arthur Lapworth.

Although bromine acts very slowly on a dilute aqueous solution of acetone, yet, in presence of alkali, bromination occurs readily. It is now found that acids also accelerate the speed of substitution to an extent which depends mainly on the concentration of the hydrogen ions, although the nature of the anion appears to have some influence.

In the author's experiments, the concentration of the bromine was always considerably less than that corresponding with one molecular proportion, and at constant temperature the velocity with which the bromine disappeared was nearly independent of its concentration. With sulphuric acid between the concentrations $0{\cdot}4N$ and $0{\cdot}04N$, the velocity increased somewhat less rapidly than the concentration of the acid, but slightly more rapidly than that of the acetone. The relative velocities of reaction with $0{\cdot}4N$ sulphuric, nitric, and hydrochloric acids were about 1·19 : 1·20 : 1·36. The velocity was not affected if the acetone was left in contact with the dilute acid for several days before the introduction of the bromine.

Preliminary experiments with chlorine indicate that in presence of much acid it is removed at about the same speed as bromine.

These facts confirm the view that the bromination is not a process of direct substitution, but is preceded by a reversible change of the acetone, accelerated by acids or alkalis, to a second form, probably the enol, this modification being brominated nearly instantaneously. It has already been shown that in many cases acids promote the attainment of equilibrium between *ketonic* and *enolic* modifications (*Trans.*, 1902, **81**, 1500, and *Proc.*, 1903, **19**, 149).

The action of acids in accelerating substitution is not confined to aqueous solutions, but may be readily followed in other solvents.

The action of bromine and chlorine on other carbonyl compounds, as, for example, malonic ester and acetic anhydride, is greatly accelerated by acids. Even dry acetic acid is readily converted into its monobromo-derivative on the water-bath if it is first saturated with hydrogen chloride or bromide. The latter observation explains the action of a small quantity of phosphorus or phosphorus halogen compounds in promoting the action of chlorine and bromine on carboxylic acids, and the introduction of a suitable amount of the acid chloride appears equally effective when the acid contains water.

101. "Reactions involving the addition of hydrogen cyanide to carbon compounds." By A. Lapworth.

In order to ascertain the conditions under which hydrogen cyanide is most rapidly taken up by carbon compounds, camphorquinone was brought into contact with that substance in the presence of different agents which might possibly influence the reaction velocity, a rough measure of the latter being obtained by noting the speed with which the colour of the quinone disappeared.

The reaction, which was very slow in aqueous solution and was retarded by acids, was extremely rapid in presence of strong bases, and was accelerated by salts of weak acids. This result indicates that the change is effected by the cyanogen ions, a view confirmed by further experiments.

The great additive power of "nascent" hydrogen cyanide as compared with that of the agent in the free state is now readily understood, as the former occurs in presence of potassium cyanide.

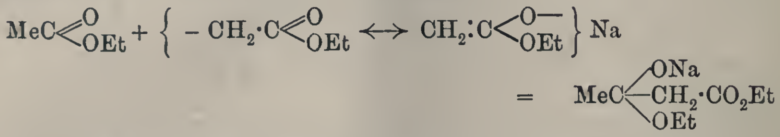
When the addition product is fairly stable towards alkalis, it is not necessary actually to liberate the hydrogen cyanide. Camphorquinone may, in a few seconds, be largely converted into its cyanohydrin by shaking with a concentrated aqueous solution of potassium cyanide. Benzylidene benzylcyanide gives more than 30 per cent. of the theoretical amount of diphenylsuccinonitrile if warmed for 20 minutes in alcoholic solution with excess of potassium cyanide, although it does not appear to unite with hydrogen cyanide in the absence of its salts; phorone is rapidly converted into phorononitrile under the same conditions.

With potassium cyanide, benzaldehyde yields mandelonitrile. The latter compound condenses with the former in presence of bases to yield hydrogen cyanide and benzoin. The well-known benzoin condensation may therefore be represented as the result of the formation of the unstable cyanohydrin of benzoin by the ordinary addition process, $CHPh(OH){\cdot}CN + PhCHO = OH{\cdot}CPh(CN){\cdot}CHPh{\cdot}OH$, where the mandelonitrile behaves as the hydroxy-derivative of benzyl cyanide, a substance which is known to condense readily with benzaldehyde.

102. "The acetoacetic ester synthesis." By A. C. O. Hann and A. Lapworth.

Within the last four years convincing evidence has been accumulated to show that Claisen's hypothesis (*Annalen*, 1897, 297, 92) as to the mechanism of the synthesis of β-ketonic esters and similar compounds by the use of sodium or sodium ethoxide is incorrect, and, moreover, the facts which led to the formulation of this theory have been shown by Dieckmann (*Ber.*, 1900, **33**, 2677) to be capable of a far simpler explanation.

The authors' observations, which are being extended, confirm the view that the acetoacetic ester synthesis is essentially the result of an addition process in which a metallo-organic compound becomes attached to the carbonyl group of an ester



$$\mathrm{MeC}{<}^{\mathrm{O}}_{\mathrm{OEt}} + \left\{ -\mathrm{CH_2{\cdot}C}{<}^{\mathrm{O}}_{\mathrm{OEt}} \longleftrightarrow \mathrm{CH_2{:}C}{<}^{\mathrm{O-}}_{\mathrm{OEt}} \right\}\mathrm{Na}$$

$$= \mathrm{MeC}\begin{matrix}\diagup\mathrm{ONa}\\ -\mathrm{CH_2{\cdot}CO_2Et}\\ \diagdown\mathrm{OEt}\end{matrix}$$

(compare Michael, *Ber.*, 1900, **33**, 3736; and Lapworth, *Trans.*, 1901, **79**, 1269).

Ethyl bromoacetate was allowed to react with certain esters in presence of zinc and magnesium; with ethyl oxalate, good yields of ethyl oxaloacetate were obtained; with ethyl acetate, the product was mainly ethyl γ-bromoacetoacetate, the latter compound being produced by an exactly similar process, excepting that the reaction occurs between two molecules of ethyl α-bromoacetate without the intervention of ethyl acetate. Fittig, Daimler, and Keller (*Annalen*, 1889, **249**, 184) employed this modification of the acetoacetic ester synthesis in preparing diethyl ketipate (diethyl oxalodiacetate), but the complete analogy between the two methods appears to have hitherto escaped notice.

103. "Rimu resin." By T. H. Easterfield and B. C. Aston.

Rimu (*Dacridium cupressinum*; natural order, *Coniferæ*) is one of the most valuable of the New Zealand timber trees, the cracks or shakes in the heart wood being nearly always partially or completely filled by a hard pink resin with a distinctly crystalline fracture.

The chief constituent (75 per cent.) of the resin, a crystalline acid, for which the name *rimuic acid* is proposed, melts at 192—193°, distils with very slight decomposition at 296—300° under 21 mm. pressure, and is optically active. It is easily soluble in alcohol or ether, and dissolves sparingly in water or light petroleum. Its formula, $C_{16}H_{20}O_3$, is supported by analysis, molecular weight determinations, titration values, and analysis of barium, lead, and silver salts. The barium compound is the most characteristic of the salts; it crystallises in well-defined, square plates having the composition $Ba(C_{16}H_{19}O_3)_2,14H_2O$. The alkali salts are very soluble and do not separate from solution in the presence of excess of alkali. Rimuic acid is lævorotatory, having $[\alpha]_D -159°$ in a 10 per cent. alcoholic solution; it yields benzoyl and acetyl derivatives, and its formula may be thus represented: $C_{15}H_{18}(OH)\cdot CO_2H$. Like most of the acids from the pine resins, it yields no esters when treated with alcohol and hydrochloric acid.

The acid yields two crystalline nitro-derivatives when nitrated in cold glacial acetic acid solution.

104. "Note on the karaka fruit." By T. H. Easterfield and B. C. Aston.

The kernel of the fruit of the Karaka tree (*Corynocarpus lævigata*; natural order, *Anacardiaceæ*), is a staple article of food amongst the Maoris and Morioris. In its raw state, it is bitter and very poisonous, but when baked and subsequently soaked in water its toxic properties disappear. Examination of the kernels shows that they contain 15 per cent. of a harmless, non-drying oil and that the aqueous extract of the nut contains mannite, mannose, and dextrose. When the extract is distilled, it yields a considerable quantity of prussic acid. From the aqueous extract, Skey obtained a bitter glucoside, karakin, which he stated, melted at 100° and contained no nitrogen; the authors find, however, that karakin is highly nitrogenous, and when pure melts at 122°. It is most readily obtained from an alcoholic extract of the kernel by removing the alcohol under diminished pressure and recrystallising the residue from warm water.

Karakin, which has the formula $C_{15}H_{24}O_{15}N_3$, crystallises in leaflets, and like amygdalin is only slightly toxic when removed from the enzymes with which it is associated. A second glucoside, *Corynocarpin*, can be obtained in small quantity by evaporating the aqueous extract at a temperature below 50° and extracting with ether. As this glucoside cannot be detected in the freshly prepared extract, and as the karakin disappears during the evaporation, it is probable that the second glucoside is a product of the partial hydrolysis of karakin. Corynocarpin crystallises in fine needles, melts at 140°, and is less soluble in hot alcohol than karakin.

105. "The slow oxidation of methane at low temperatures. II." By W. A. Bone and R. V. Wheeler.

The authors describe an apparatus for the closer investigation of slow combustion processes. This is essentially a closed system in which the reacting gaseous mixture can be circulated day and night continuously, at a uniform rate, (1) over a heated surface the temperature of which is kept constant, and (2) through suitable washing and cooling vessels for the removal of soluble or condensable intermediate products. A specially devised manometer allows of pressure records being taken at regular intervals, so that the velocity of the oxidation may be measured.

Further experiments with this apparatus on the interaction of methane (2 volumes) and oxygen (1 volume) at 450° and 500°, whilst they entirely confirm the authors' previous conclusion that neither hydrogen nor carbon is liberated at any stage of the oxidation, and that the final products consist simply of carbon monoxide, carbon dioxide, and steam, have proved the transient formation of formaldehyde as an intermediate product. In one experiment, 13 per cent., and in another as much as 22 per cent., of the methane burnt was obtained as formaldehyde which had been rapidly removed from the sphere of action by passing the reacting mixture through cold water each time it left the tube containing the heated surface.

The authors conclude that the oxidation of methane involves the following stages :—

(1) The simultaneous formation of formaldehyde and steam, by the bimolecular reaction, $CH_4 + O_2 = CH_2O + H_2O$.

(2) The further oxidation of this formaldehyde to carbon monoxide, carbon dioxide, and steam. This is probably effected as the result of the simultaneous occurrence of the following reactions :—

(*a*) The bimolecular reaction, $CH_2O + O_2 = CO_2 + H_2O$.

(*b*) The trimolecular reaction, $2CH_2O + O_2 = 2CO + H_2O$.

106. "The alkylation of sugars." By T. Purdie and J. C. Irvine.

The method of alkylating hydroxyl groups by means of dry silver oxide and alkyl iodides does not appear directly applicable to aldoses or ketoses, and leads to oxidation and subsequent changes of some complexity; but α-methylglucoside and cane sugar can be methylated by means of this reaction. α-Methylglucoside, when methylated in methyl-alcoholic solution, yields a mixture of methyl glucose ethers; the main constituent, trimethyl α-methylglucoside, which can be isolated by fractional distillation, is a viscid syrup; it boils at 167—170° under 17 mm. pressure, exhibits dextrorotation, and has no action on Fehling's solution.

Complete methylation of trimethyl α-methylglucoside is readily effected with silver oxide in methyl iodide solution, and under these conditions, tetramethyl α-methylglucoside is obtained as a comparatively mobile liquid boiling at 144—145° under 17 mm. pressure; it is dextrorotatory, and has no action on Fehling's solution. Tetramethyl glucose, which is produced by hydrolysing the tetramethylated glucoside with dilute hydrochloric acid, distils without decomposition at 182—185° under 20 mm. pressure, and solidifies slowly and crystallises from light petroleum in tufts of radiating needles, melting at 81—83°; it behaves like an aldose, reducing warm Fehling's solution, giving tetramethylgluconic acid on oxidation, and reacting with phenylhydrazine in molecular proportion to form an oil, which is apparently a hydrazone. Tetramethyl glucose is dextrorotatory, but does not exhibit any notable multirotation.

The production from α-methylglucoside of a tetramethylgluconic acid, capable of forming a lactone, proves conclusively that the oxygen of the ring in the formula of the alkylglucosides is coupled with the γ-, and not with the β-carbon atom.

A pentamethylated glucose, isomeric with the tetramethyl α-methylglucoside already mentioned, is produced when a solution of tetramethyl glucose in methyl iodide is treated with silver oxide; it boils at 124—127° under 8 mm. pressure, crystallises in slender prisms melting at 42—43°, and is lævorotatory.

Methylfructoside behaves like the corresponding glucoside, and, when completely methylated, yields tetramethyl methylfructoside; the two hydroxyl groups of acetone rhamnoside may also be methylated in a similar manner.

Cane sugar, on methylation, yields a neutral oil, which has no action on Fehling's solution until it is hydrolysed. The products of hydrolysis are the above-mentioned crystalline tetramethyl glucose and an uncrystallisable syrup, which is probably the corresponding methylated lævulose.

The fact that methylated cane sugar and methylated methylglucoside give on hydrolysis the same tetramethyl glucose proves that the constitution and linking of the glucose group of the disaccharide is the same as that of the simple glucoside, and affords conclusive evidence, at least so far as the glucose half of the molecule is concerned, of the correctness of Fischer's formula for cane sugar (*Ber.*, 1893, 26, 2404).

107. "Trimethyl α-methylglucoside and trimethyl glucose." By T. Purdie and R. C. Bridgett.

When α-methylglucoside, in methyl-alcoholic solution, is methylated by means of dry silver oxide and methyl iodide, the chief product is trimethyl α-methylglucoside. In preparing this compound, it was found that, in addition to the lower methylated derivatives, the tetramethylated glucoside was also produced, but only in small quantity, even when a large excess of the alkylating agent was used. The last hydroxyl group to be methylated undergoes the change more slowly than the others, and it seems therefore probable that the unmethylated hydroxyl of the trimethyl α-methylglucoside is that of the terminal primary carbinol group of the glucoside. The difficulty encountered in completing the methylation is, however, largely due to the loss of alkylating material caused by the production of dimethyl ether. Special experiments showed that the action between silver oxide and methyl iodide is much more rapid in the presence of methyl alcohol, and that the production of dimethyl ether is probably due, not to the direct interaction of the oxide and iodide, but to the methylation of alcohol.

The specific rotation of the trimethyl α-methylglucoside, prepared by the authors was much in excess of that exhibited by the specimen referred to in the preceding note. The preparation of tetramethyl α-methylglucoside was also repeated, and the substance was found to be more dextrorotatory than the specimens previously examined. The discordant results may be due to intramolecular rearrangement occurring under the action of methyl iodide, resulting in the production of varying quantities of the corresponding stereoisomeric β-glucosides.

By hydrolysing trimethyl α-methylglucoside with dilute hydrochloric acid, trimethyl glucose was obtained as a viscid, colourless syrup, which distilled without appreciable decomposition at about 194° under 9 mm. pressure. The substance, which was dextrorotatory and had the properties of an aldose, reduced Fehling solution in the cold, and ammoniacal silver nitrate on slightly warming; it appeared to react with phenylhydrazine, but the product, which was an oil, could not be made to crystallise. On oxidation with bromine water, it yielded an oil boiling at about 160° under 11 mm. pressure. The numbers obtained by analysis, and from the estimation of methoxyl, agreed approximately with those required for trimethylgluconic lactone. The lactonic nature of the compound was confirmed by its behaviour on neutralisation, and by the gradual change of optical activity exhibited by its solution.

108. "Note on the corrosion of an Egyptian image."
By Henry Bassett, jun.

An examination has been made of a bronze Egyptian image, about 6 inches high, and having a hollow base filled with lead. This figure probably dates from 200 to 100 B.C., and now bears a mutilated inscription which, according to Professor Flinders Petrie, reads as follows: "Khonsu give life to – – – – –, son of – – – – p, born of

Saaenhap." It was found in the delta of the Nile and is very extensively corroded, being covered by a thick, green coating, which in parts entirely replaces the original metal.

The material for analysis was obtained from the base of the figure, and the following analytical results were obtained :

Cu …………	50·65	per cent.	$CuCl_2$ …………	29·34	per cent.
Pb …………	6·74	,,	CuO …………	46·10	,,
Sn …………	2·94	,,	H_2O …………	11·07	,,
Fe …………	0·15	,,	SnO_2 …………	3·73	,,
Ni, Mn, &c.	0·11	,,	PbO …………	7·26	,,
Cl ……… …	15·71	,,	Fe_2O_3 …………	0·22	,,
SiO_2 (as sand)	1·14	,,	NiO, &c.………	0·14	,,
H_2O ………	11·07	,,	SiO_2 …………	1·14	,,
(NH_4) ………	0·11	,,	NH_4Cl ………	0·32	,,
	88·62			99·32	

In the second table, the chlorine has been calculated as copper chloride, whilst the remaining copper and other metals are expressed as oxides.

Traces of calcium were also found, but the amount of sodium present was so small that it could only be detected by the flame test. If all the copper were present in the form of a basic chloride, $CuCl_2,3CuO,3H_2O$, corresponding with atacamite, this would require 26·84 per cent. $CuCl_2$, 47·57 per cent. CuO, and 10·78 per cent. H_2O. It will therefore be seen that the substance produced by corrosion is less basic than atacamite. The formation of this mineral during the corrosion of copper and bronze articles when buried in the soil has been shown by Berthelot to be very general (*Compt. rend.*, 1894, **118**, 768), but although the formation of this basic copper chloride is in most cases due to the action of the sodium chloride in the soil (Berthelot, *loc. cit.*), yet in the present instance, ammonium chloride may have played the most important part, since the latter salt was found in amount sufficient for estimation, whereas the former was not.

109. "Contributions to the chemistry of the terpenes. Part I. The oxidation of pinene with chromyl chloride." By G. G. Henderson, T. Gray, and E. Smith.

When dissolved in carbon disulphide, chromyl chloride and pinene combine to form a solid compound, $C_{10}H_{16},2CrO_2Cl_2$, which is decomposed by water and yields a brown, oily liquid. This liquid, when distilled in steam, yields a quantity of resin and a volatile oil (Étard, *Compt. rend.*, 1893, **116**, 434). The authors have found that the oil contains a saturated *aldehyde*, $C_9H_{15}\cdot CHO$, an unsaturated *ketone*, $C_8H_{14}\colon CO$, and a small quantity of a chlorinated oxidation product of pinene. The aldehyde, which is a crystalline solid with a characteristic odour, melts at 32—33° and boils at 205—207° (under 755 mm. pressure); it is insoluble in water, but readily miscible with alcohol and ether. The *semicarbazone* crystallises in pearly leaflets and melts at 191°. The aldehyde rapidly undergoes spontaneous oxidation in the air, being converted into a saturated *acid*, $C_9H_{15}\cdot CO_2H$. This acid, which is obtained by oxidising the aldehyde with either boiling dilute nitric acid or aqueous potassium permanganate, crystallises in leaflets or flat prisms, and melts at 117°; it is only sparingly soluble in cold water, but very readily so in alcohol, and volatilises slowly in steam. The *lead* salt and the *silver* salt are obtained as white precipitates; both are soluble in boiling water, but the latter very sparingly.

The ketone is an almost colourless, aromatic liquid, which boils at 206—207° under 774 mm. pressure; its refractive index is 1·4760. The ketone at once decolorises permanganate, and combines additively with 1 mol. of bromine; it yields an oily *oxime* and a crystalline *semicarbazone*, which melts and decomposes at 226—228°; on oxidation with sodium hypobromite, it gives bromoform and *p*-toluic acid.

110. "Some physical and chemical properties of strong nitric acid." By V. H. Veley and J. J. Manley.

The investigations published by W. N. Hartley in the current number of the *Transactions* (p. 658) on the absorption spectra of nitric acid in various states of concentration have induced the authors to place on record certain physical and chemical properties of nitric acid varying in concentration from 78 to 100 per cent. HNO_3 in continuation of their former work (*Proc. Roy. Soc.*, 1901, **69**, 86, and *Phil. Mag.*, 1902, [vi], **3**, 118).

Although such properties as density, contraction, refractive indices, and electrical conductivity vary uniformly with percentage concentration from 78 to 92 per cent., yet from this point to 100 per cent. there is an exceptional alteration in the variation, reaching a maximum at about 96 per cent., this strength corresponding with an acid which, according to Hartley's view, might be indicated by the formula $3H_2N_2O_6,H_3NO_4$ (= 95·9 per cent. HNO_3).

Acid having this concentration appears to form a kind of eutectic solution, and therefore presents an analogous, although not strictly parallel case to that of sulphuric acid containing 98 per cent. H_2SO_4, which has been shown by R. Knietzsch (*Ber.*, 1901, **34**, 4069) to be a point of critical concentration as regards density, contraction (compare

Pickering, *Trans.*, 1890, 57, 74), electrical conductivity, chemical reactivity, vapour pressure, and, to a less degree, capillarity and viscosity.

As regards chemical properties, certain qualitative experiments have been made on the direct nitration of cotton by nitric acid of approximately 100 per cent. concentration without the addition of sulphuric acid.

111. "Notes on ozone." By J. K. H. Inglis.

Experiments have been made in order to ascertain the molecular state of ozone when dissolved in acids. In the first place, it was found that the amount of ozone present in an acid solution could be determined by means of the following reaction: $O_3 + 2HBr = Br_2 + O_2 + H_2O$, the bromine liberated being estimated by potassium iodide and sodium thiosulphate.

In the second place, an investigation of the solubility of ozone in water showed that the solution could not be brought into equilibrium with respect to the gas, since some of the latter was always decomposed on being bubbled through the solution, although the concentration of the latter remained constant. Hence, the molecular state cannot be ascertained by means of the solubility relationship.

Lastly, some experiments made on the action of ozone on hydrogen peroxide indicated that these substances acted slowly on one another, manganous sulphate behaving as a catalyser.

ERRATUM.

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Page	Line	
147	9*	*for* "ammonia," *read* "methylamine."

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* From bottom.

Issued 14/11/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 270.

Extraordinary General Meeting, July 2nd, 1903. Professor TILDEN, F.R.S., President, in the chair.

The PRESIDENT stated that this meeting had been summoned to consider the following changes in the Bye-laws which had been proposed at one meeting of the Council, and considered and approved at a subsequent meeting.

It was proposed by the Treasurer, Dr. H. T. BROWN, and seconded by Professor THORPE,

"That Bye-law I., page 13, lines 3 and 4, be altered by *deleting* the words "one year."

The Bye-law at present reads :—

> ". . . .; and he shall "be entitled, so long as his annual subscription be not one "year in arrear, to one copy of the annual publications of the "Society. . . . ."

And that the Circulars in the Appendix be altered as follows :—

In Appendix, No. 2, "Letter notifying the Election of a Member," 5th and 6th lines, p. 26, *delete* the words "the Assistant Secretary." After the words "before admission,*" *add* the words "Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in."

In No. 3, "Annual Circular Letter of Treasurer," *delete* from "If paid" to end of circular, and *substitute* the same words as added in No. 2.

In No. 4, "Annual Circular Letter of the Treasurer to Fellows who are two years in arrear of their Subscriptions," *delete* from "Payments should be made" to end of circular, and *substitute* the same words as added in No. 2.

The motion having been submitted to the meeting was declared by the President to have been carried unanimously.

The following are abstracts of papers received during the vacation, and published or passed for publication in the *Transactions*.

112. "The composition of so-called elæomargaric acid." By T. Kametaka.

Maquenne having recently shown that the composition of Cloez's elæomargaric acid is more closely expressed by $C_{18}H_{30}O_2$ than by the formula $C_{17}H_{30}O_2$ adopted by Cloez, the author adduces evidence from his own work on the oil of *Elæococca vernicia* to show that the true formula for the acid is $C_{18}H_{32}O_2$. This proof depends on the formation of the bromine additive product, $C_{18}H_{32}O_2Br_4$, and on the result of the oxidation of the acid by permanganate, the product consisting of sativic acid, $C_{18}H_{32}(OH)_4O_2$, and a small amount of another hydroxy-acid, apparently dihydroxystearic acid. Titrations with standard caustic alkali and baryta solutions give, as a mean result, 280·5 for the molecular weight of elæomargaric acid, whilst $C_{18}H_{32}O_2$ requires 280.

113. "Phosphoric amidines." By R. M. Caven.

Phenyl-*p*-tolylphosphoric amidine, $C_6H_5NH \cdot PO \colon N \cdot C_6H_4CH_3$, which is formed as a by-product in preparing anilino-*p*-toluidinophosphoryl chloride (*Trans.*, 1902, 81, 1369), is identical with a compound obtained in the preparation of *p*-toluidinoanilinophosphoryl chloride, and which should accordingly have the formula $C_6H_4(CH_3) \cdot NH \cdot PO \colon N \cdot C_6H_5$. This identity is not to be attributed to the mobility of a hydrogen atom (compare von Pechmann, *Ber.*, 1895, 28, 869 and 2362), but to the fact that the disubstituted phosphoryl chloride, in whichever way prepared, is one and the same substance, and that the derived amidine, whether a single substance or a mixture, results from the withdrawal of hydrogen chloride by the action of the substituting base.

Diphenylphosphoric amidine, $C_6H_5NH{\cdot}PO{:}NC_6H_5$, and di-*p*-tolylphosphoric amidine were prepared from dianilino- and di-*p*-toluidinophosphoryl chlorides respectively.

The formation of such amidines from the diarylaminophosphoryl chlorides by the elimination of hydrogen chloride is facilitated by the agency of basic oxides such as those of silver, mercury, and magnesium.

114. "The mechanism of combustion." By H. E. Armstrong.

Assuming that chemical interchange and electrolysis are interchangeable equivalent terms, the author regards oxidation as an indirect process, inasmuch as the oxygen used is only indirectly incorporated with the oxidised matter ; the oxidation takes place in a circuit composed of the oxidisable substance, conducting water and oxygen, the last of these acting as the depolariser. The results obtained by Bone and Wheeler are discussed in the light of this hypothesis. It is contended that in the case of methane, for example, oxygen is introduced atom by atom and that a substance such as carbon monoxide is a secondary product, not a direct product of oxidation nor of preferential oxidation of the carbon.

115. "The constituents of the volatile oil of the bark of *Cinnamomum pedatinervium* of Fiji." By E. Goulding.

The bark of *Cinnamomum pedatinervium*, a tree indigenous to Fiji, on distillation with steam, yields nearly 1 per cent. of a volatile oil which is almost colourless when first distilled, but gradually assumes a yellowish-brown colour. This oil has a sweet, aromatic odour, a pungent, spicy taste, sp. gr. 0·964 at 15°/15°, $[\alpha]_D$ $-4{\cdot}96°$ and n_D 1·4963. Its chief constituents are : (i) a *terpene*, $C_{10}H_{16}$, which has a sp. gr. 0·8659 at 15°/15°, $[\alpha]_D$ $-17{\cdot}72°$, and yields an uncrystallisable *dibromide*, $C_{10}H_{16}Br_2$; (ii) linalool ; (iii) safrole ; (iv) eugenol ; and probably (v) eugenol methyl ether. The quantitative composition of the oil is approximately as follows : terpene, 15—20 per cent. ; alcohols, 30 per cent. ; esters, 1·5 per cent. ; safrole, 40—50 per cent. ; eugenol, 1 per cent. ; and 3 per cent. of eugenol methyl ether (?).

116. "Condensation of phenols with esters of unsaturated acids. Part VIII." By S. Ruhemann.

The compounds formed from α-naphthol and ethyl chlorofumarate must be formulated as derivatives of α-naphthaketocoumaran (compare

Trans., 1902, **81**, 419), because although guaiacol reacts with ethyl chlorofumarate to yield only ethyl guaiacoloxyfumarate, yet its isomeride, the monomethyl ether of resorcinol, condenses with the ester to furnish ethyl *m*-methoxyphenoxyfumarate and an orange-coloured ketocoumaran derivative, which is called *dimethoxybisbenzaronyl.*

The latter derivative has properties similar to those recorded for bisnaphtharonyl; both compounds are reduced to colourless ketocoumaran derivatives by zinc dust and acetic acid, these reduction products being readily oxidised and converted into red substances.

Ethyl phenylpropiolate, when condensed with the monomethyl ether of resorcinol, yields ethyl *m*-methoxy-β-phenoxycinnamate, the free acid of which loses carbon dioxide on heating and furnishes *m*-methoxyphenoxystyrene.

The diethyl ether of phloroglucinol reacts with ethyl chlorofumarate to form ethyl diethoxyphenoxyfumarate, and with ethyl phenylpropiolate to yield ethyl diethoxyphenoxycinnamate.

117. "Action of phosphorus trichloride on the aromatic ethers of glycerol. Part II." By D. R. Boyd.

The study of the action of phosphorus trichloride on glycerol diaryl ethers has been extended (*Trans.*, 1901, **79**, 1221), and the following substances have been prepared: s-*glycerol di*-o-*tolyl ether* (β-*hydroxy*-$\alpha\gamma$-*di*-o-*tolyloxypropane*) boiling at 226° under 13 mm. pressure and melting at 36—37°; the corresponding meta-compound boiling at 232° (13 mm.); *bisdi*-o-*tolyloxy*iso*propyl phosphite* and its para-*isomeride*, which melt at 118—119° and 81—82° respectively; *di*-o- and *di*-m-*tolyloxy*iso*propylphosphorous acids* melting respectively at 88—89° and 85—87°, and certain of their metallic salts.

118. "Attempts to prepare isomeric quaternary salts." By M. Barrowcliff and F. S. Kipping.

In view of the probable existence of isomeric salts of the type $\begin{matrix}R_1\\R_1\end{matrix}\!\!>\!NR_2R_3R_4$ (*Trans.*, 1903, **83**, 873), the authors have investigated some compounds of this class, including certain salts of the ethylpropylpiperidinium base already studied by Miss C. de Brereton Evans (*Trans.*, 1897, **71**, 522); but although in all cases one of the radicles consisted of an optically active group, no indication whatever of the existence of isomerides has been observed.

Ethylpropylpiperidinium d-*bromocamphorsulphonate*,

$$C_5H_{10}NEtPr\cdot SO_3\cdot C_{10}H_{14}BrO,$$

crystallises in needles melting at 211°; it is very readily soluble in water and chloroform, sparingly so in ethyl acetate, and insoluble in ether and light petroleum. *Benzylmethylpiperidinium* d-*bromocamphorsulphonate*, $C_5H_{10}NMeBz\cdot SO_3\cdot C_{10}H_{14}BrO$, melts at 160° when anhydrous and generally resembles the preceding compound. *Ethylpiperidine* d-*bromocamphorsulphonate*, $C_5H_{10}NEt,C_{10}H_{14}BrO\cdot SO_3H$, crystallises in needles melting at 158°.

These three salts, when repeatedly crystallised fractionally from various solvents under different conditions, did not yield dissimilar fractions. Molecular weight determinations made with ethylpropylpiperidinium iodide seem to show that whereas in aqueous solution the salt is ionically dissociated in a normal manner, yet in chloroform solution it is associated, possibly forming trimolecular complexes.

119. "Some salts of *d*- and *l*-α-phenylethylamines." By A. E. Hunter and F. S. Kipping.

The authors have investigated several salts of the *d*- and *l*-components of *dl*-phenylethylamine in the hope of obtaining isomerides corresponding with those derived from hydrindamine, but without success.

When the d-*bromocamphorsulphonate* of the *dl*-base is fractionally crystallised from water, it affords a salt which separates in prisms melting at 206—207°, and having in aqueous solution a molecular rotation identical with that of the *d*-bromo-acid, namely, $[M]_D + 271°$; this salt, however, is not partially racemic, as might be inferred from its optical properties, but is the compound of the *l*-base; the salt of the *d*-base was not isolated.

Although the ion of the *l*-base appears to be devoid of optical activity, the free base is distinctly lævorotatory in aqueous alcoholic solution, its specific rotation being about $[\alpha]_D - 25°$; this behaviour is similar to that of the *d*- and *l*-hydrindamines.

The *benzoyl* derivative, prepared from *l*-α-phenylethylamine by the Schotten-Baumann method, melts at 120°, is optically inactive, and seems to be identical with that of the *dl*-base.

l-α-*Phenylethylamine* d-*chlorocamphorsulphonate* melts at about 198° and has in aqueous solution a molecular rotation practically identical with that of the *d*-chloro-acid, namely, $[M]_D + 186°$.

l-α-*Phenylethylamine* d-*camphorsulphonate* melts at 149—150° and is practically indistinguishable by polarimetric examination from the corresponding salt of the *dl*-base, both substances having a molecular rotation approximating very closely to that of the acid; apparently the salt of the *dl*-base is not a definite partially racemic substance.

120. "β-Bromocinnamic acids." By J. J. Sudborough and K. J. Thompson.

Small amounts of β-bromo*allo*cinnamic acid (m. p. 159—160°) are obtained by the action of alkalis on cinnamic acid dibromide, but are not produced when the ethyl ester is used instead of the free acid dibromide.

In aqueous solution, the products of the combination of hydrogen bromide and phenylpropiolic acids consist entirely of β-bromo- and β-bromo*allo*-cinnamic acids; the relative amounts of the two isomerides being but slightly affected by light, temperature, or concentration of the solvent. The nature of the combination is materially affected by the medium in which the hydrogen bromide is dissolved; when acetic acid is used, more of the β-bromo-acid and less of the β-bromo*allo*-acid are obtained than when saturated aqueous solutions are employed. With benzene and carbon disulphide, the chief product is α-bromocinnamic acid.

Similar results have been met with in the combination of ethyl phenylpropiolate and hydrogen bromide.

Under the influence of alkalis, β-bromocinnamic acid and its esters lose hydrogen bromide much more readily than the β-bromo*allo*-acid and its esters.

Attempts have been made to prepare Michael's *iso*cinnamic acid in order to determine whether either the *allo*- or the *iso*-acid could be resolved into optically active constituents by the aid of active bases. The experiments made on the reduction of the β-bromo*allo*-acid indicate that the product, which consists of *allo*cinnamic acid with a trace of ordinary cinnamic acid, does not contain the *iso*-acid.

121. "Vapour pressure of aqueous ammonia solution. Part II." By E. P. Perman.

The partial pressures of the ammonia and water-vapour evolved by an aqueous ammonia solution have been found by aspirating a known volume of air through the solution and estimating the amounts of ammonia and water withdrawn. The experiments were made at temperatures ranging from 0° to 60°, and the concentration of the solutions employed varied from 0 to 22·5 per cent. of ammonia.

It was found that the sum of the partial pressures was equal to the total pressure determined by the statical method, and also that the relationship between the partial pressures and the concentration of the solution is that deduced by Duhem and others for binary mixtures of liquids.

122. "Isomeric aminoamidines of the naphthalene series. (Fourth communication on anhydro-bases.)" By R. Meldola, J. V. Eyre, and J. H. Lane.

The authors have succeeded in isolating the free base, ethenyltriaminonaphthalene, obtained by the reduction of dinitro-α-acetonaphthalide by tin and hydrochloric acid. The compound is characterised by its tendency to form complex hydrates containing 9½, 3½ or 1½ mols. of water. The *acetate*, $C_{12}H_{11}N_3,C_2H_4O_2,H_2O$, *oxalate*, $C_{12}H_{11}N_3,C_2H_2O_4,2H_2O$, and *mercurichloride*,

$$C_{12}H_{11}N_3,HCl,HgCl_2,1\tfrac{1}{2}H_2O,$$

have been prepared.

The *N*-ethyl derivative of the acetyl derivative having the formula $C_{16}H_{17}ON_3,\tfrac{1}{2}H_2O$ has been obtained, and characterised by the formation of its *picrate*, $C_{16}H_{17}ON_3,C_6H_2(NO_2)_3OH,H_2O$, and *aurichloride*, $C_{16}H_{17}ON_3,HAuCl_4,2H_2O$.

By eliminating the NH_2 group in the ethenyltriaminonaphthalene by the diazo-method, an ethenyldiaminonaphthalene (methylnaphthimidazole) has been obtained, which differs from the only compound of this formula at present known (Prager, *Ber.*, 1885, **18**, 2161). The isomerism of the aminoamidines has thus been proved to extend to the parent compounds, so that the cause of the isomerism is to be sought in the structure of the amidine ring. The following salts and derivatives have been prepared: *hydrochloride*, $C_{12}H_{10}N_2,HCl,H_2O$, *chromate*, $C_{12}H_{10}N_2,H_2CrO_4,2H_2O$, and *picrate*.

The base itself has the formula $C_{12}H_{10}N_2,H_2O$, and the water could not be expelled without decomposing the compound. The amidine ring apparently breaks down by the action of benzoyl chloride in presence of alkali with the formation of dibenzoyl-*o*-naphthylenediamine. The N-*methyl* derivative, an oily base, has a crystalline *picrate* $C_{13}H_{12}N_2,C_6H_2(NO_2)_3OH$. The crystalline N-*ethyl* derivative, $C_{14}H_{14}N_2$ is anhydrous and yields the following crystalline salts: *chromate*, $C_{14}H_{14}N_2,H_2CrO_4$, and *picrate*, $C_{14}H_{14}N_2,C_6H_2(NO_2)_3OH,H_2O$; its *aurichloride* contains $2H_2O$ and, when heated in the water-oven, becomes converted into the monohydrate. The *platinichloride* also yields hydrates containing 4, 2, and 1 mols. of water.

The *N*-ethyl derivative of the known ethenyldiaminonaphthalene (compare Otto Fischer, *Ber.*, 1901, **34**, 935) prepared for comparison with its isomeride, is found to be resinous, but the *chromate*, *picrate*, *platinichloride*, and *aurichloride* are well characterised.

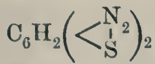
The ethenyltriaminonaphthalene, obtained by the reduction of dinitro-α-acetonaphthalide by iron and hydrochloric acid (Markfeldt's base) yields a crystalline *oxalate* with $4H_2O$ and a *mercurichloride*,

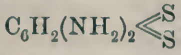
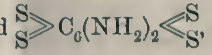
$C_{12}H_{11}N_3,2HCl,HgCl_2,5H_2O$. Its benzoyl derivative has now been prepared by the Schotten-Baumann method (compare *Trans.*, 1900, 77, 1165).

Ethenyltriaminonaphthalene (Meldola and Streatfeild's base) is converted into its isomeride (Markfeldt's) by further reduction with iron and hydrochloric acid, but reduction with sodium amalgam in the presence of acetic acid does not bring about this transformation. Reduction of dinitro-α-acetonaphthalide with zinc and hydrochloric acid gives the original (M. and S.) base.

123. "Polythiosulphonic acids of *p*-diamines." By A. G. Green and A. G. Perkin.

The series of polythiosulphonic acids of *p*-diamines formerly prepared by one of the authors in collaboration with A. Meyenberg (compare Eng. Pat. Specifications, Nos. 21832, ^{98}; 22460, ^{98}; 22847, ^{98}; 5039, ^{99}; 18658, ^{99}; and 4792, ^{00}) are well-crystallised compounds which, when oxidised together with primary amines and diamines, give rise to a series of black colouring matters possessing the characteristic properties of "sulphide" colours. The present communication deals with the further characterisation of these polythiosulphonic acids, especially of the di- and tetra-thiosulphonic acids of *p*-phenylenediamine, $C_6H_2(NH_2)_2(S{\cdot}SO_3H)_2$ and $C_6(NH_2)_2(S{\cdot}SO_3H)_4$, which are obtained by the oxidation of *p*-phenylenediamine in the presence of sodium thiosulphate, using 2 or 4 molecular proportions of the latter with a corresponding quantity of the oxidising agent.

Owing to the presence of the S_2O_3H groups in ortho-positions with respect to the amino-radicles, the *p*-phenylenediaminedithiosulphonic acid exhibits several characteristic condensations. Thus, with nitrous acid it gives a stable bisdiazosulphide,  $C_6H_2\left(<\begin{matrix}N_2\\ | \\ S\end{matrix}\right)_2$; with organic anhydrides or with aldehydes, it gives anhydro-compounds.

On boiling the di- or tetra-thiosulphonic acid with aqueous acids, sulphurous and sulphuric acids are eliminated, and yellow or red salts of sulphide bases are obtained. These bases, which appear to have the constitution  $C_6H_2(NH_2)_2<\begin{matrix}S\\S\end{matrix}$ and  $\begin{matrix}S\\S\end{matrix}>C_6(NH_2)_2<\begin{matrix}S\\S\end{matrix}$, are of dark colour, insoluble in water and other solvents, but dissolving in an aqueous solution of sodium sulphide, in which respect they resemble the "sulphide" colours; they are reconverted into the respective polythiosulphonic acids by prolonged treatment with sulphurous acid in the presence of air.

When treated with zinc dust, the dithiosulphonic acid is reduced to the disulphydride $C_6H_2(NH_2)_2(SH)_2$.

124. "The rotation of the menthyl esters of the isomeric chlorobenzoic acids." By J. B. Cohen and S. H. C. Briggs.

The authors have prepared the menthyl esters of the mono- and di-chlorobenzoic acids, and have compared their specific and molecular rotations.

The following represents the order of optical activity, beginning with the least active: 2 : 6; 2 : 3; ortho; 2 : 5; 2 : 4; 3 : 4; 3 : 5; unsubstituted; meta; para. These results lead to the following conclusions: (1) the greatest effect (decrease) in the rotation of the unsubstituted menthyl ester is produced when the halogen enters the ortho-position with respect to the carboxyl group; the least, when the halogen is in the meta- and para-positions, which, singly, slightly increase the rotation. (2) The monohalogen derivatives accord with the rule laid down by Frankland and Wharton (*Trans.*, 1896, **69**, 1320, 1583), and confirmed by Guye and Babel (*Abstr.*, 1899, ii, 719) and Tschugaeff (*Abstr.*, 1903, ii, 2), and follow the order: ortho, unsubstituted, meta, para.

(3) Two halogens attached to adjoining carbon atoms (2 : 3 and 3 : 4) produce a greater effect than either singly.

It might be expected that the rotations of the 2 : 3- and 2 : 5-esters would be approximately the same, inasmuch as the chlorine atoms in both isomerides occupy the ortho- and meta-positions with respect to the carboxyl group, but in reality the rotation of the 2 : 3-ester is much lower, and that of the 2 : 5-isomeride slightly higher than the value obtained for the ortho-compound.

The low rotation of the 3 : 4- and 3 : 5-esters does not support the theory of the lever-arm (Frankland and Wharton, *loc. cit.*).

125. "The reaction between phosphorus and oxygen. Part I." By E. J. Russell.

A small quantity of water is necessary for the oxidation of phosphorus, and the reaction proceeds most rapidly when that amount is present which is left after drying with sulphuric acid. In the presence of much water vapour, action is considerably retarded. The formation of ozone and hydrogen peroxide requires the presence of excess of water; these bodies are not direct products of the reaction between phosphorus and oxygen.

Moderately dried phosphorus and oxygen react under all the pressures employed, and the phenomena of false equilibrium are not seen. The reaction may be divided into two stages: in the first, oxidation is slow and accompanied by a very feeble glow, the action being apparently unimolecular; the oxide formed is still under investigation. The second stage begins when the pressure falls below about 500 mm.; oxidation is continuously accelerated until all the oxygen is absorbed. The luminosity is very marked, and phosphorus pentoxide is formed. No simple expression could be found connecting the velocity of oxidation with the pressure of oxygen.

When an inert gas, such as nitrogen, is present, the phenomena are substantially the same, but the acceleration of the second period ceases after a time and a retardation sets in. This variation is, however, explained on a purely mechanical hypothesis.

When phosphorus oxidises in moist oxygen, the reaction differs from that taking place in dry oxygen in the following respects:

(*a*). It does not begin until the pressure of oxygen is less than about 500 mm.; when it does take place it is slower, and is much retarded during the earlier part of the reaction. The retardation is explained as being due to a protective film formed by the water on the phosphorus.

(*b*). Ozone and hydrogen peroxide are produced, and, in presence of nitrogen, these substances are accompanied by ammonium nitrite and nitrate. None of the theories at present held completely accounts for these observations.

If smaller quantities of water are present (4 or 5 mm. pressure instead of 16 or 20 mm.), the velocity curve does not differ greatly from that obtained in the absence of water. And the difference observed when the higher quantity of water is present can readily be explained as being due to the protective layer of this liquid. There is no reason to suppose that the primary reaction between the phosphorus and oxygen differs in the two cases.

126. "Action of hydrogen peroxide on carbohydrates in the presence of ferrous sulphate. IV." By R. S. Morrell and J. M. Crofts.

The substances formed by adding hydrogen peroxide solutions of arabinose and rhamnose in the presence of ferrous sulphate yielded osazones with phenylhydrazine acetate, and it was therefore considered that arabinose and rhamnose had been oxidised to the corresponding osones (*Trans.*, 1899, **75**, 786, and 1900, **77**, 1219). Aqueous solutions of these two osones have been found to react at the ordinary temperature with *p*-bromophenylhydrazine, giving rise to osazones. The action of larger quantities of hydrogen peroxide on glucose and fructose has been investigated, and the metallic salts of glyoxylic, glycollic, and trihydroxybutyric acids have been obtained. The formation of glycollic acid from glucose is peculiar, and is not easily accounted for on the assumption that the sugar molecule is transformed into an osone before a disruption of the carbon chain takes place.

127. "Ethyl benzylideneanilineacetoacetate." By R. S. Morrell and A. E. Bellars.

The authors find that the action of benzylideneaniline on ethyl acetoacetate gives rise to ethyl benzylideneanilineacetoacetate, which melts between 78° and 80° after recrystallisation from benzene and carbon tetrachloride. The addition of piperidine or minute quantities of sodium ethoxide does not cause any change in the melting point of the recrystallised addition product (compare Schiff, *Ber.*, 1898, **31**, 207; Rabe, *ibid.*, 1902, **35**, 3950; Francis, *ibid.*, 1902, **35**, 3949), but the solvents used in the recrystallisation must be pure, otherwise it is impossible to obtain the ethyl benzylideneanilineacetoacetate with a constant melting point. The addition of small quantities of sodium ethoxide to a mixture of benzylideneaniline and ethyl acetoacetate causes the formation of a mixture of β_1- and β_2-forms of ethyl benzylidenediacetoacetate (Rabe, *Annalen*, 1900, 313, 176). The molecular weight of the ethyl benzylideneanilineacetoacetate in benzene or carbon tetrachloride solution decreases as the solution becomes more dilute, and also on heating or when it is kept for some time.

128. "Studies on enzyme action. I. The correlation of the stereoisomeric α- and β-glucosides with the corresponding glucoses." By E. F. Armstrong.

The stereoisomeric α- and β-alkyl glucoses have been converted, by means of enzymes, into the corresponding glucosides. It is thus shown that glucose has a lactonic structure, and consists, in solution, of a mixture of two stereoisomeric lactones. The changes in rotatory power which dissolved glucose undergoes involves the passage of one or other form of the lactone into a mixture of the two.

129. "A dynamical study of the Friedel-Crafts reaction." By B. D. Steele.

In order to determine, if possible, the mechanism of the Friedel-Crafts reaction, the synthesis of phenyl tolyl ketone from toluene and benzoyl chloride in presence of aluminium or ferric chloride, and that of phenyltolylmethane from toluene and benzyl chloride in presence of the same condensing agents have been studied dynamically.

The course of the reaction in each case was followed by passing a rapid current of hydrogen through the reaction mixture, and titrating the hydrochloric acid thus carried over.

The following conclusions have been deduced:

(1) In the synthesis of a ketone from a hydrocarbon and an acid chloride in the presence of aluminium chloride, the explanation suggested by Perrier (*Ber.*, 1900, 33, 815) and by Boeseken (*Rec. trav. him.*, 1900, 19, 19; 1901, 20, 102) seems to be quite justifiable, providing that the aluminium chloride is not present in excess.

(2) In the presence of an excess of the condensing agents, the reaction, instead of being unimolecular, becomes bimolecular, and is best explained by assuming that the reagents are two intermediate compounds, each containing aluminium chloride.

(3) In the presence of ferric chloride, the reaction is also bimolecular, and is best explained on the foregoing assumption.

(4) The synthesis of phenyltolylmethane from toluene and benzyl chloride, in the presence of either aluminium or ferric chloride, is a unimolecular reaction, due to the interaction of the toluene and a compound of the organic and metallic chlorides.

Thursday, November 5th, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs C. N. Bennett, G. Barger, H. Gough, W. Mann, C. D. Bibby, and S. H. Woodhouse were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

Robert Duncombe Abell, Ph.D., D.Sc., Sandbach, Cheshire.
Percy Appleyard, Albany, Western Australia.
Edward F. Armstong, Ph.D., 55, Granville Park, Lewisham, S.E.
Herbert Henry Ashdown, 3, Genesta Road, Plumstead.
Herbert Moore Attwell, Limpley Stoke, Bath.
William C. Badcock, B.A., The Grammar School, Crediton, Devon.
Harold J. Bailey, 40, The Avenue, Pontypridd, South Wales.
Thomas Vipond Barker, Exeter College, Oxford.
Charles Marsh Beadnell, H.M.S. Barracouta, Capetown.
William Beam, M.A., M.D., Pension Sima, Cairo, Egypt.
Harold Goodenough Bayly, "Moatside," Bedford.
Henry James Wheeler Bliss, Balliol College, Oxford.

Nicholas John Bluman, 10, Amersham Road, New Cross, S.E.
Paul Brühl, Engineering College, Sibpur, near Calcutta.
Erasmus Robert Buggé, 327, Grove Green Road, Leytonstone.
William Clacher, Bryantwood, Auckland Road, Ilford.
William Thomas Deeks, High Street, Shanklin, I.W.
Henry Russell Ellis, 177, Warwick Road, W.
Charles E. Fawsitt, Ph.D., B.Sc., 9, Foremount Terrace, Glasgow.
John A. N. Friend, M.Sc., 2, Francis Road, Watford, Herts.
Ernest A. Gardiner, B.A., Bretherton, near Preston, Lancs.
Frank B. Gatehouse, 56, Windmill Street, Gravesend, Kent.
Frank B. Grundy, Red Lodge, King's Road, Richmond, S.W.
John T. Hall, West View, Stanwell, Staines.
Harold M. Heasman, 1, Carlisle Road, Finsbury Park, N.
Arthur V. Hendrickson, Gas Works, Lower Sydenham, S.E.
John G. Howarth, "Danes Dyke," Capstone Road, Bournemouth.
Herbert Hymans, 13, Trinity Square, E.C.
Edward Charles Ibbotson, 3, Ashgate Road, Sheffield.
William H. Jackson, 73, Church Street, West Hartlepool.
Thomas Oliver Kent, 89, Loughboro' Park, Brixton, S.W.
John J. Kielty, 71, Cairo Road, Walthamstow.
Harley F. Knight, 64, Amhurst Park, Stamford Hill, N.
John Laing, Everlie, Skelmorlie, N.B.
Francis E. E. Lamplough, B.A., Trinity College, Cambridge.
Harold Duff Leadbetter, 95, Capel Road, Forest Gate, E.
Gervaise Le Bas, B.Sc., Baymont House, St. Aubins, Jersey.
David B. Macdonald, 18, Kimberley Road, Leicester.
Frederick W. McMahon, 61, Brockley Rise, Forest Hill, S.E.
Ernest W. Mann, Willow Avenue, Edgbaston, Birmingham.
Gordon W. Monier-Williams, B A., The Lammas, Esher, Surrey.
Urban O. S. Nairne, 7, Hawthorne Terrace, Barking, Essex.
James Victor Nevin, Bristol Dispensary, Bristol.
Henry George Pike, Downton, Salisbury, Wilts.
George Horace G. Plymen, 2, Melton Road, Leicester.
William Branch Pollard, B.A., 68, Finnart Street, Greenock, N.B.
Stiles W. G. Rich, Stanley Street, South Brisbane, Queensland.
Harold E. Richardson, B.A., B.Sc., 63, Lansdowne Road, Ilford.
William David Rogers, 36, Grange Road, Smethwick.
George Senter, Ph.D., B.Sc., 37, Ronalds Road, Highbury, N.
Arthur Slator, Ph.D., M.Sc., The Priory, Burton-on-Trent.
William V. Smith, B.A., 7, Grove Road, Ipswich Road, Norwich.
A. W. Stewart, B.Sc., 18, Annfield Terrace, Partick Hill, Glasgow.
Arthur Tighe, 20, Marlborough Place, St. John's Wood, N.W.
Arnold Turner, 316, Entwisle Road, Rochdale.
William E. S. Turner, B.Sc., 52, Cheshire Road, Smethwick.

Miles Walker-Pole, Braamfontein, Johannesburg.
Carl F. R. Weiss, Ph.D., M.A., Victoria Park, Manchester.
Fred Wright, Terry Street, Balmain, N.S.W.

Certificates in favour of the following were authorised by the Council for presentation for ballot under Bye-law I. (3):

Thein Kin, Rangoon, Burma.
Mata Prasad, Benares, India.
P. W. Robertson, Wellington, New Zealand.

The PRESIDENT announced that the Council had decided that a supplementary number of the Transactions should be issued on December 31st, and that after that date the Journal would be issued on the last day of each month instead of the first day of the month as hitherto, the first number for 1904 being issued on January 31st.

The PRESIDENT then reminded the Society of the announcement he had been permitted to make at the meeting on May 20th in reference to the bust of Dalton which was now before them, and read the following letter from Professor Thorpe.

GOVERNMENT LABORATORY,
LONDON, W.C.

October, 1903.

DEAR MR. PRESIDENT,

Although the walls of the Society's apartments are adorned with busts, medallions and other mementoes of eminent chemists, there is among them no memorial of one of the most illustrious of all chemists—John Dalton.

As a fellow-townsman of Dalton, may I be permitted, in grateful remembrance of the fact that my early education was promoted by a studentship founded in his memory and associated with his name, to supply, in some small measure, the lack of such a memorial, and to ask that the Council will do me the honour to accept the bronze bust which accompanies this letter?

As you are aware, this month one hundred years ago saw the promulgation of Dalton's great generalisation. There is, therefore, I venture to hope, a special fitness in preferring my request at this particular time.

The bronze is the work of Miss Levick, who is already favourably known to the Society by her reproduction of the bust of Davy in their possession. Of the artistic merits of her present work others must be the judge, but I may be permitted here to express my indebtedness to her for the skill and conscientious care with which she has striven to make a faithful and adequate presentment of the grand old philosopher. She has been greatly assisted by the kindness and co-operation of many friends to whom my acknowledgments are due. Practically all the available material has been placed at her disposal—the copy of the well-known Chantrey bust in the possession of the Literary and Philosophical Society of Manchester; the Cardwell bust belonging to Owens College; a beautiful but little known steel engraving by Stephenson, given to me by my friend Dr. Blackley; the portrait in the possession of the Royal Society; the precious daguerreotype formerly in the possession of Dalton's friend and pupil the late Mr. John Dale, and now the property of the Society; together with a number of other drawings and engravings.

I am gratified to know that those who are competent to form an opinion have expressed the conviction that Miss Levick has made admirable use of her ample material, and that she has succeeded not only in reproducing the lineaments of the great chemist, but in infusing into them a conception of the simplicity, dignity and grandeur of his character.

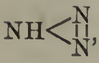
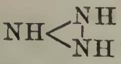
I am, Dear Mr. President,
Faithfully yours,
T. E. THORPE.

The Council had that afternoon passed a resolution tendering to Dr. Thorpe an expression of most cordial thanks for his generous and interesting gift.

Of the following papers, those marked * were read:

*130. "The reduction of hydrazoic acid." By W. T. Cooke.

Apart from Peratoner and Oddo's observation (*Gazzetta*, 1895, **25**, 2) that ammonia is formed at the cathode when hydrazoic acid is electrolysed, the behaviour of hydrazoic acid when subjected to reducing agents does not appear to have been studied.

Considering the acid as a cyclic compound having the formula  $NH\Big<\begin{array}{l}N\\ \|\\ N\end{array}$, the first step in its reduction should lead to the formation of the hydride,  $NH\Big<\begin{array}{l}NH\\ |\\ NH\end{array}$, but the existence of this hypothetical compound seems doubtful in view of the ease with which nitrogen hydrides pass into ammonia. On the other hand, boron, which has even less affinity for hydrogen than nitrogen, forms the corresponding hydride, B_3H_3 (Ramsay and Hatfield, *Proc.*, 1901, 17, 152), so that N_3H_3 may possibly exist as a gas with feebly basic properties. Further reduction would, however, result in a breaking up of the ring, with the formation of ammonia, and possibly hydrazine, as an intermediate product. These substances were actually obtained when the following reducing agents were tried: sodium amalgam, zinc and either hydrochloric or sulphuric acid, sodium polysulphide, and ferrous hydroxide.

Ammonia was the chief product, and the hydrazine, which was generally present in small quantities, was obtained in appreciable amount only in those experiments where it was removed from solution in the form of an insoluble compound during the reaction. It may, however, be formed at first in accordance with the equation $NH{\cdot}N_2 + 3H_2 = NH_3 + N_2H_4$, and then at once reduced, for trial reduction experiments, in which hydrazine sulphate was used instead of hydrazoic acid, showed that some ammonia was formed.

The hydrazoic acid was made by the method devised by Wislicenus (*Ber.*, 1892, 25, 2084), and was employed in approximately decinormal solution.

The products of reduction were separated from the mixture by distillation from an alkaline solution, the distilling flask being provided with a "Kjeldahl" bulb; in most cases, the distillates, when acidified with hydrochloric acid and concentrated, showed a slight reducing action towards ammoniacal silver nitrate, Fehling's solution, &c.; the residues in the distilling flasks also produced the same effect. This result might be anticipated since hydrazine hydrate is less volatile in steam than ammonia. The latter substance was recognised by its odour, alkalinity, reaction with Nessler's reagent, and the analyses of its platinichloride.

In reducing with sodium amalgam, the solid reagent was slowly added to separate quantities each consisting of 50 to 100 c.c. of acid, so as to maintain a slight effervescence. After about a week, the liquid was decanted from the mercury and distilled. Reduction proceeded more quickly in acid solution, but the hydrazoic acid was easily lost.

The addition of sodium amalgam to freshly precipitated silver hydrazoate, which had been carefully washed until free from acid, and suspended in water, caused the separation of silver, which partly went into solution in the colloidal condition, giving the liquid a dark brown colour.

The hydrazoic acid readily attacked zinc, and when the effervescence had subsided, sulphuric, or occasionally hydrochloric, acid was gradually added in small quantities. In the case of sulphuric acid, a granular deposit of the double salt, $(N_2H_4)_2H_2SO_4,ZnSO_4$ (*Ber.*, 1893, 26, 410), was formed on allowing the reaction to continue for at least a week.

A solution of this salt, which is fairly soluble in hot water, easily reduces an acid solution of gold chloride. The precipitate of cadmium sulphide obtained on mixing solutions of cadmium hydrazoate and sodium polysulphide was collected after a few days, when the filtrate was found to contain a small quantity of ammonia.

An alkaline solution of sodium hydrazoate was used in the case of ferrous hydroxide, and the reduction was carried on at the boiling temperature in a current of hydrogen, the ammonia evolved being collected in dilute acid. The mixture in the flask was distilled while still alkaline, and again when acidified with sulphuric acid, the latter operation being performed in order to recover the unused hydrazoic acid.

Similar experiments were also made on the reduction of hydrazine sulphate with zinc or sodium amalgam; in both instances, a small amount of ammonia was formed. In the case of zinc and sulphuric acid, the formation of an appreciable amount of hydrogen sulphide was noticed at the beginning of the reduction.

These results show that it is possible by the use of reducing agents to split the hydrazoic ring, and that there is certainly no tendency for the ring to become saturated by the addition of two atoms of hydrogen.

*131. "Preliminary note on the viscosity of liquid mixtures." By A. E. Dunstan and W. H. C. Jemmett.

Three typical liquid mixtures have been used in this research, namely: (1) ethyl acetate and benzene; (2) benzene and ethyl alcohol; (3) ethyl alcohol and water.

The apparatus used was of Ostwald's pattern; the viscometer was immersed in a bath, which was kept at 25° by means of a thermostat, and was stirred by a current of carbon dioxide.

In the first mixture, which consisted of a pair of non-associative unimolecular liquids, the viscosity was an additive property, and an almost straight line curve was obtained having a slight concavity. Neither liquid has much effect on the other; the concavity probably indicates slight association.

A similar result was also obtained in the case of a mixture of benzene and carbon disulphide.

In the second mixture, where only the alcohol was associative, a minimum point was reached when about 6 per cent. of alcohol was present; the remaining part of the curve was normal. This minimum point is probably due to further association of alcohol molecules. It has been shown in freezing point determinations that alcohol in benzene gives abnormally high results, and Pickering has recognised a break in the freezing point curve corresponding with 6 per cent. of alcohol.

In the third case, both liquids are associative, and as the percentage of either constituent increased, there was a strongly marked rise of viscosity, which culminated in a maximum point, corresponding with 55·83 per cent. of alcohol. At this point, the proportion of alcohol and water is very approximately 2 mols. water to 1 mol. alcohol. I. Traube (*Ber.*, 1886, 19, 871) indicates maxima of a similar nature for this mixture at about 46—50 per cent. alcohol. Pickering has shown that in the freezing point curve of alcohol in water there is a break at 53 per cent. (Trans., 1893, 63, 1012).

In the case of the third mixture, each substance possibly dissociates the associated molecules of the other, thus giving rise to an increased number of active particles. Jones and Murray (*Amer. Chem. J.*, 1903, 30, 193) have shown that such dissociation is the case for several associative bodies. This would explain the gradually increasing viscosity up to the maximum point corresponding with $2H_2O—C_2H_5OH$.

The work is being extended to other liquid mixtures.

*132. "A contribution to the study of the reactions of hydrogen peroxide." By J. McLachlan.

When solutions of hydrogen peroxide and potassium bichromate are mixed and boiled with sulphuric acid, the volume of oxygen evolved is not equal to twice the available oxygen of the hydrogen peroxide. The available oxygen in the peroxide solution was estimated by iodometry, the object being to find the available oxygen in 0·56 c.c. of the sample of the peroxide, as this figure represents the volume of 0·0008 gram of oxygen. It is essential that the solution of the peroxide should be dilute, and the sulphuric acid solution should not be stronger than 1 in 5. When stronger solutions of sulphuric acid are added to a solution of potassium iodide, a considerable quantity of iodine is set free before the peroxide solution is added.

The proximate cause of the ready production of iodine when stronger solutions of sulphuric acid are added to a solution of pure potassium iodide is believed to be dissolved oxygen. If, in such a solution containing some starch paste, the blue colour is destroyed by a drop or two of a centinormal sodium thiosulphate solution, the coloration reappears after a definite number of minutes. This regeneration of the blue colour, after its destruction by the thiosulphate solution, will go on for weeks, perhaps for months or even years, until either the potassium iodide or the sulphuric acid has been used up. With hydrochloric acid, the blue colour is reproduced in about one-seventh of the time required for its reappearance when the equivalent amount of sulphuric acid is employed, and hydriodic acid is almost as active. Tartaric acid is about as active as sulphuric acid, phosphoric acid not not quite so active, oxalic acid still less so, whilst with boric acid the time required for the development of the blue colour is about four days.

The estimation of the available oxygen in a solution of peroxide of hydrogen by an acidified solution of potassium permanganate has been found to be utterly untrustworthy.

Estimations have been made of the available oxygen of manganese dioxide (1) in its original state, (2) after being boiled with a solution of hydrogen peroxide, (3) after being boiled with a solution of hydrogen peroxide and sulphuric acid, the process employed being the oxalic acid method, in which a known weight of manganese dioxide, mixed with a known volume of a normal solution of oxalic acid, and excess of sulphuric acid (1 in 3) is heated until the whole of the dioxide is decomposed, and the excess of oxalic acid then estimated by a standard solution of potassium permanganate. The hydrogen peroxide solution should be added only after the manganese dioxide and sulphuric acid are thoroughly mixed.

The results indicate that (1) the manganese dioxide is not decomposed by the hydrogen peroxide in accordance with the equation $MnO_2 + H_2O_2 = MnO + H_2O + O_2$, as in reality only a portion of the oxygen is evolved, (2) the presence of sulphuric acid is absolutely essential, for without it the foregoing reaction does not occur.

Discussion.

Dr. Divers said that his own experience, as well as that of others, was that a mixture of *pure* potassium iodide and *pure* sulphuric acid if sufficiently dilute would remain colourless in the dark for hours in the presence of starch, even when exposed in an open vessel. In contact with the air, such a likely impurity as a very minute quantity of nitrous acid, although too small to cause an immediate effect, acted slowly as a carrier of oxygen and produced an intense coloration.

Dr. McLachlan, in reply, said that every effort was made to secure pure potassium iodide. Moreover, the action of traces of iodate or nitrous acid would not be an adequate explanation of the phenomena, unless such substances were normal constituents of the atmosphere as distinct from the air of a chemical laboratory.

*133. "The constitution of certain silicates." By C. Simmonds.

Silicates of lead, copper, iron, cobalt, and nickel are reduced when heated to redness in hydrogen, and as a rule a silicate containing x atoms of lead or copper yields x atoms of oxygen. A few naturally occurring ferruginous silicates behave exceptionally under these conditions, some giving up only a portion of the corresponding oxygen, whilst others yield none. The reduced silicates are black powders which, except in the case of lead orthosilicate, do not appear to contain any notable amount of the reduced element in the metallic state.

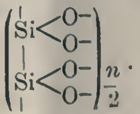
The formulæ usually adopted do not furnish a simple interpretation of the results obtained on reduction. In lead metasilicate, $\mathrm{O{:}Si}<\begin{smallmatrix}\mathrm{O}\\ \mathrm{O}\end{smallmatrix}>\mathrm{Pb}$, for example, the two oxygen atoms connected with the metal are represented as occupying precisely similar positions in the molecule, and there is no apparent reason why only one should be removed by hydrogen.

The formula of such a silicate ought, however, to indicate that at least one atom of oxygen (the displaceable one) is attached to each atom of lead, and also that this labile oxygen is linked to the metal in a manner differing from the mode of attachment of any other oxygen atom.

The configuration which satisfies the prescribed conditions most completely is that having the grouping $>\mathrm{Si}<\begin{smallmatrix}\mathrm{O\cdot Pb}\\ \ \ \ | \\ \mathrm{O\cdot O}\end{smallmatrix}$.

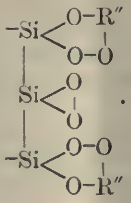
The following conclusions have been deduced:

(*a*) The silicon atoms are in direct combination with one another, and not joined by means of oxygen. (*b*) To the chain of silicon atoms thus formed the oxygen corresponding with $(SiO_2)_n$ is attached, giving rise to a mode of grouping denoted by the formula



$$\left(\begin{matrix} | \\ \mathrm{Si}<\begin{matrix}\mathrm{O-}\\ \mathrm{O-}\end{matrix} \\ | \\ \mathrm{Si}<\begin{matrix}\mathrm{O-}\\ \mathrm{O-}\end{matrix} \\ | \end{matrix}\right)_{\frac{n}{2}}.$$

(*c*) The oxygen valencies still unappropriated are those by which the basic oxides (PbO, CuO, &c.) become attached to the silica complex. (*d*) The conception of silicate structure to which these deductions lead is that of a chain, either closed or open, of the following type:



The two free silicon valencies would presumably unite, the silicate thus acquiring a closed chain or ring structure. Or they may possibly be connected by another molecular group—Al_2O_3, for instance—also giving rise to a ring. They might also conceivably be attached to any univalent atoms or groups, thus forming an open chain.

Whether the above type of structure is the rule or the exception is at present uncertain, but that some diversity exists is shown by the behaviour of those ferruginous silicates (for example, staurolite, augite, and epidote) which are not reduced by hydrogen at a red heat. Possibly, although not necessarily, these differences may be due to the occurrence of an entirely different kind of structure.

The natural silicates which have, so far, been found to undergo practically complete reduction (in the sense already explained) are dioptase, chrysocolla, garnierite, connarite, chloropal, glauconite, cronstedtite, and thuringite. Ilvaite and stilpnomelane show considerable, but not complete, reduction, this action being much less marked in the case of hypersthene.

Discussion.

Mr. C. E. **Groves** asked the author whether he had treated the *reduced* lead silicate with pure mercury and some acid, such as acetic acid, which did not act either on lead or mercury in order to ascertain whether the lead present in this reduced residue was in the metallic state. If it were not, and the author's formula for lead metasilicate, for instance, $\left(\overset{|}{\underset{|}{\mathrm{Si}}}<\begin{matrix}\mathrm{O\cdot Pb}\\ \quad\ |\\ \mathrm{O\cdot O}\end{matrix}\right)_n$, be accepted, the reduced product must be a remarkable lead-silicon compound having the formula $\left(\overset{|}{\underset{|}{\mathrm{Si}}}<\begin{matrix}\mathrm{O}\\ \mathrm{O}\end{matrix}>\mathrm{Pb}\right)_n$.

Mr. **Simmonds**, in reply, said that he had experimented with mercury, but not with acetic acid, when testing the reduced silicate residues for metallic lead, and he hoped to deal with the matter more fully at some future date. The composition of these residues, however, was a question quite distinct from the one discussed in the paper.

*134. "The constitution of chrysophanic acid and of emodin." By H. A. D. Jowett and C. E. Potter.

The authors discussed the evidence bearing on the positions of the substituting groups in the formulæ for chrysophanic acid and emodin. They concluded that chrysophanic acid must be represented as 5 : 8-dihydroxy-1-methylanthraquinone, as previously suggested by Hesse, and emodin as 2 : 5 : 8- or 3 : 5 : 8-trihydroxy-1-methylanthraquinone.

Emodin, on fusion with caustic alkali or on oxidation with permanganate, yielded no definite product.

By the action of sodium and methyl iodide on emodin, only the *monomethyl ether*, $C_{16}H_{12}O_4$ (m. p. 200°), was formed; its *diacetyl* compound melts at 157°. This emodin methyl ether appeared to differ from the naturally occurring product obtained by Perkin (*Trans.*, 1894, 65, 932). Attempts to synthesise the foregoing di- and tri-hydroxymethylanthraquinones by the condensation of hydroxysalicylic acid with substituted *o*- and *m*-toluic acids, and also of 1-methylphthalic anhydride with quinol, were unsuccessful.

By the condensation of two molecules of hydroxy-*p*-toluic acid ($CH_3 : OH = 1 : 2$), three isomeric dihydroxydimethylanthraquinones were produced.

3 : 5-*Dihydroxy*-2 : 6-*dimethylanthraquinone*, $C_{16}H_{12}O_4$, which formed yellow leaflets not melting below 300°, yielded a *diacetyl* compound (m. p. 215°) and a *monomethyl ether* (m. p. 214—215°); the latter formed a *monoacetyl* compound (m. p. 195—196°).

1 : 5-*Dihydroxy*-2 : 6-*dimethylanthraquinone* formed red needles (m. p. 224—225°), did not yield a methyl ether, and was insoluble in dilute ammonia.

3 : 7-*Dihydroxy*-2 : 6-*dimethylanthraquinone* formed orange-yellow needles (m. p. 232°) and readily dissolved in dilute ammonia to a red solution.

135. "Conductivity of substances dissolved in certain liquefied gases. Preliminary notice." By B. D. Steele and D. McIntosh.

The authors have studied the behaviour of salt solutions in hydrogen chloride, bromide, iodide, sulphide, and phosphide.

In view of the known dissociation of salts when dissolved in hydrogen fluoride, water, or liquefied ammonia gas, it was anticipated that the foregoing solvents would all behave as ionising media. This anticipation has, however, been only partially realised.

In hydrogen chloride solution, sodium chloride, potassium iodide, ferric chloride, and water do not conduct at all; potassium permanganate, sodium acetate, ammonium oxalate, and ammonium chloride diminish the resistance only very slightly, whilst potassium cyanide and several haloid salts of the amines yield highly conducting solutions.

Trichloroacetic acid, sodium chloride, and water do not conduct in hydrogen bromide solution; potassium iodide and potassium bromide conduct very slightly, whereas ammonium acetate, potassium cyanide, diethylammonium chloride, and tetramethylammonium chloride conduct well.

Potassium cyanide, potassium iodide, phosphonium iodide, and water do not diminish the resistance of hydrogen iodide solution, whilst the haloid salts of the amines reduce it considerably.

In hydrogen sulphide solution, hydrochloric acid, sulphuric acid, sodium chloride, and sodium sulphide do not conduct, ammonium chloride conducts only slightly, but ammonium sulphide and the salts of the amines greatly diminish the resistance of the solvent.

Phosphonium iodide, potassium iodide, sodium acetate, ammonium acetate, potassium cyanide, and the salts of the amines do not appreciably reduce the resistance of hydrogen phosphide.

The salts of some of the ammonium bases greatly reduce the resistance of the first four solvents but do not diminish that of liquefied phosphine, and no salt has yet been found which will reduce to any appreciable extent the resistance of this solvent.

It is at present impossible to state whether the cases of non-conduction are due to the insolubility of the salts or to solution unaccompanied by ionisation, but systematic quantitative experiments are being made on the foregoing solvents.

136. "The behaviour of metallic oxides towards fused boric anhydride." By C. H. Burgess and A. Holt, jun.

The authors have investigated the action of fused boric anhydride on many metallic oxides, and find that only a limited number dissolve. Lithium, sodium, potassium, cæsium, and rubidium, as carbonates, readily dissolve in boric anhydride in all proportions up to saturation, giving clear glasses, and thallium behaves in the same way. With a very large amount of alkali, however, the glass becomes opaque.

Calcium, strontium, barium, zinc, cadmium, magnesium, manganese, lead, and bismuth oxides are insoluble in small quantities, but, on gradually increasing the amount, dissolve to clear glasses; with a further addition of oxide, the mass again becomes opaque except in the cases of lead and bismuth, which yield pale yellow, very fusible glasses.

The oxide of mercury appears to be soluble, and those of antimony and arsenic slightly so. The oxides of aluminium, beryllium, zirconium, tin, cerium, thorium, niobium, and silicon are all quite insoluble. The oxides which colour the borax bead, namely, those of chromium, copper, molybdenum, uranium, iron, nickel, and cobalt, are all insoluble in the fused anhydride, the manganese oxides in this respect behaving exceptionally.

The last series of oxides can, however, be dissolved in boric anhydride containing lithium, potassium, cæsium, rubidium, and thallium, and the clear glasses obtained with large amounts of the coloured oxides were similar to the borax beads although the colours were sometimes modified.

137. "Note on some reactions of vanadium tetrachloride."

By B. D. Steele.

In a series of experiments undertaken with the object of ascertaining whether vanadium tetrachloride might not find useful application as a chlorinating and condensing agent, it was found that on adding this reagent to benzene, a small quantity of a dark mauve solid was precipitated, the yield of this substance was much increased by boiling the mixture, and 13 grams of dried solid were obtained from 25 grams of benzene and 15 grams of vanadium tetrachloride. Analyses showed that the atomic ratio of chlorine to vanadium varied from 3·08 to 2·73, whilst that between carbon and hydrogen was found to be one. The substance rapidly decreased in weight at the ordinary temperature, and a freshly prepared sample, when heated at 100°, evolved benzene and diminished by 50 per cent., the calculated percentage loss in weight for the compound $VCl_3(C_6H_6)_2$ being 49·7. In the above reaction, the vanadium tetrachloride was reduced to trichloride, and the liberated chlorine atom attacked the benzene molecule, evolving hydrogen chloride and giving rise to chlorobenzene or some other more highly chlorinated substitution products of benzene.

Vanadium tetrachloride failed entirely to bring about chlorination in the case of nitrobenzene, but was used successfully in chlorinating benzene.

When a rapid current of chlorine was passed into a mixture of 4·5 grams of the chloride and 100 grams of benzene, hydrochloric acid was copiously evolved, and sufficient heat was developed to raise the temperature of the solution nearly to its boiling point. On fractionating the product after removal of the vanadium compounds, a considerable quantity of substance boiling between 128° and 132° was obtained, which was identified as chlorobenzene. Crystals of hexachlorobenzene melting at 155° were isolated from the small residue left in the distilling flask.

Vanadium tetrachloride has no value as a condensing agent for use in the laboratory. Acetyl chloride and benzene, when condensed in its presence, gave only a very small yield of acetophenone, and other experiments in this direction led to equally unfavourable results.

It was found that when the mauve compound, $VCl_3(C_6H_6)_2$, reacted with ether, heat was developed and a blue solution was produced which, on evaporation over sulphuric acid in a desiccator, yielded fine, blue, tabular crystals; these could only be kept in the presence of an excess of ether and in a dry atmosphere. Satisfactory analyses of this compound could not be made on account of its instability.

138. "Studies on comparative cryoscopy. Part I. The fatty acids and their derivatives in phenol solution." By P. W. Robertson.

The rate of association of a given compound in any solvent is termed the "assoce," and the constant has been determined for the fatty acids and their derivatives in phenol solution.

The assoce of the normal fatty acids alternately rises and falls as the series is ascended. If the even members are considered, this coefficient reaches a minimum at hexoic acid and then rises rapidly. It is shown that the subsequent rise is probably due to a different kind of association, inasmuch as it is caused by the hydrocarbon portion of the molecule.

The assoce is influenced both by the nature and by the position of a substituting group, and, generally, halogens, alkyl radicles of low molecular weight, and phenyl and benzyl groups have the same influence. In all cases, when these radicles are introduced into the α-position with respect to the carboxyl group the assoce is reduced, but in the other non-contiguous positions they have little or no effect.

Dicarboxylic acids associate more rapidly than the acids from which they are derived, but here again replacement of the α-hydrogen atoms causes a reduction in the rate of association. α-Hydroxyl radicles increase the assoce, but substituted amino-groups tend to change its sign. It is noteworthy that the di- and tri-carboxylic acids and the α-amino-acids are exceedingly insoluble in phenol.

The rates of association of the substituted acetic acids are intimately connected with their velocities of etherification.

139. "Vapour pressures of sulphuric acid solutions. Preliminary note." By B. C. Burt.

Regnault's determinations of the vapour pressure of sulphuric acid solutions were carried out for concentrations varying from 24 to 84 per cent. at temperatures ranging from 5° to 30°. The vapour pressures are now being determined through wider limits of temperature and concentration by means of a modified form of the apparatus described by Innes (*Trans.*, 1902, 81, 683).

The sulphuric acid solutions are heated in a large Jena glass Beckmann tube, having a stout platinum wire sealed through the bottom. Regular ebullition is ensured by the use of small glass beads, and the tube is kept at a constant temperature by a copper jacket containing a suitable liquid boiling under a known pressure.

The experimental tube is connected to a large reservoir, the pressure of which is kept constant by means of the regulator described by Innes. By suitably adjusting the pressure, which is observed to 0·1 mm. by a mercury manometer, the sulphuric acid can be boiled at any required temperature, this being read off by special normal Jena glass mercury thermometers (Goetze).

The appended results indicate the accuracy of the method:

Series A.

Concentration of acid in percentages.	Temperature.	Vapour pressure in mm.
54·70	131°	637·1
54·70	131	637·2
62·07	131	497·9
62·07	131	497·7
62·07	131	497·7
72·88	132	200·2
72·88	132	200·3
79·57	132·5	70·2
79·57	132·5	70·2

Series B.

Concentration of acid in percentages.	Temperature.	Vapour pressure in mm.
72·88	157°	421·6
72·88	157	421·5
79·57	157	182·4
79·57	157	182·2

Chlorobenzene was used as the boiling liquid in series *A*, and bromobenzene in series *B*.

140. "Additive compounds of *s*-trinitrobenzene and alkylated arylamines." By H. Hibbert and J. J. Sudborough.

Mono- and di-alkylated naphthylamines form definite additive compounds with *s*-trinitrobenzene which closely resemble the similar products obtained from *a*- and *β*-naphthylamines and the same trinitro-compound. They are stable, red or purplish-black, crystalline substances, and may be crystallised from all the ordinary solvents, including glacial acetic acid, without being resolved into their components, but are readily decomposed by hot dilute mineral acids.

Molecular weight determinations in dilute benzene solution indicate that the dissolved compounds are almost completely resolved into their components.

Most of the monoalkylated derivatives, like the compounds from *a*- and *β*-naphthylamines, may be acetylated, whereas the additive compounds from the tertiary bases may be boiled with acetic anhydride for hours without undergoing change.

A *benzoyl* derivative has been obtained by the action of benzoyl chloride and alkali hydroxides on *a*-naphthylamine trinitrobenzene; it melts at 131—132° and is identical with the compound formed by the union of benzo-*a*-naphthalide and *s*-trinitrobenzene. *Ethyl-a-naphthylamine* s-*trinitrobenzene* melts at 153·5—154°, and the corresponding *diethyl* compound at 95—95·5°. *Dimethyl-a-naphthylamine* s-*trinitrobenzene* melts at 105—106°, and *ethyl-β-naphthylamine* s-*trinitrobenzene* at 106°, *ethylaceto-β-naphthalide* s-*trinitrobenzene* and *diethyl-β-naphthylamine* s-*trinitrobenzene* melt at 77—78° and 116° respectively.

Mono- and di-alkylated anilines also combine with *s*-trinitrobenzene, but the products are extremely unstable, and when crystallised from any of the ordinary solvents, or when exposed to the air at the ordinary temperature, are readily decomposed into their components.

141. "Interaction between chloric and hydriodic acids."
By J. McCrae.

The action of chloric acid on hydriodic acid is known to take place according to the equation $6H^{\cdot} + ClO_3' + 6I' = 3I_2 + Cl' + 3H_2O$, and its velocity has been studied by the compensation method by Bray (*J. Physical Chem.*, 1903, 7, 92). Some experiments on this subject had been carried out prior to the publication of Bray's work, but as they only confirmed these results, the work has been discontinued.

The method at first adopted was to mix definite volumes of standard solutions of potassium chlorate and potassium iodide and add a known volume of N sulphuric acid, so that the concentrations were accurately known. When no acid is added, iodine is not separated, even after 12 months, when the solution is allowed to remain at the ordinary temperature and exposed to daylight. The velocity of the reaction is dependent on the concentration of hydrogen ions, and the reaction is an extremely suitable one for demonstrating the velocity of reaction. If 10 c.c. of 0·2 N potassium chlorate solution, 60 c.c. of 0·2 N potassium iodide solution, and 15 c.c. of N sulphuric acid are mixed, the solution remains almost colourless for a few minutes ; a little of the mixture may then be warmed to show that the velocity is accelerated by rise of temperature. In the course of some hours, the intensity of the coloration increases perceptibly, but it is only after six or seven weeks that the maximum reaction has taken place at the ordinary temperature. After definite intervals of time, portions of the solution were titrated with $N/100$ sodium thiosulphate solution, and the velocity of reaction calculated in the ordinary way.

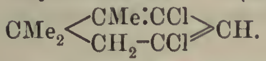
During the course of some experiments with excess of potassium chlorate, it was observed that the concentration of the iodine in solution rose to a maximum and then diminished ; at the same time, much iodine had volatilised on to the cork of the flask containing the solution. The same experiment was then made in a glass-stoppered bottle. The maximum intensity of coloration in this case was apparently reached in about six weeks, and soon after iodine began to crystallise out. After about 11 or 12 weeks, the solution was quite colourless, and some very well-developed crystals of iodine were found in the bottle. About two months after the solution had become colourless, the iodine crystals had completely disappeared As there was still the chance of leakage, the same experiment was carried out in a sealed tube. Five c.c. of $N/5$ potassium iodine solution, 45 c.c. of $N/5$ potassium chlorate solution, and 15 c.c. of N sulphuric acid were sealed in a wide glass tube, which was then freely exposed to the light. So far as could be judged by the eye, the maximum intensity of coloration was reached in about 24 days, and on the 27th day, crystals of iodine began to separate. The colour of the solution than began todiminish in intensity, and after about 50 days the colour disappeared completely and the quantity of iodine separated was considerable. The iodine then began to dissolve slowly, and after about five months (from the beginning of the experiment) the whole of the iodine passed completely into solution without imparting any colour to the solution ; during the period in which this dissolution was taking place, it was frequently noticed that in proximity with each iodine crystal, a yellow solution was formed, as if the iodine were being dissolved *per se*.

These results suggest that the reaction proceeds further than is denoted by the above equation, and they do not suggest in any way that a definite equilibrium is established.

Saturated solutions of potassium chlorate were sealed in tubes (1) with a small amount of iodine, and (2) with a large excess of iodine. In both cases, the iodine dissolved and the solution became yellow; the intensity of coloration appeared to increase progressively to a maximum after several days, and after four months there is no perceptible evidence of any diminution of the coloration. The fact that the colour only slowly developed shows that it is not due simply to physical dissolution of the iodine in the potassium chlorate solution, but suggests that a chemical reaction has taken place whereby potassium iodide or iodine ions have been formed, which then cause the iodine to pass into solution. As no acid was used in these cases, it is at present not possible to see what bearing the results have on the previous case, where the reaction takes place in presence of acid.

142. "3:5-Dichloro-1:1:2-trimethyl-$\Delta^{2:4}$-dihydrobenzene. A correction." By A. W. Crossley.

Some time ago (*Trans.*, 1901, **79**, 144), the author described a substance obtained by the action of phosphorus pentachloride on trimethyldihydroresorcin as 3:5-dichloro-1:1:2-trimethyl-$\Delta^{2:4}$-dihydrobenzene ($\Delta^{2:6}$-dichloro-3:4:4-trimethyldihydrobenzene),



$$CMe_2{<}\begin{matrix}CMe{:}CCl\\CH_2{-}CCl\end{matrix}{>}CH.$$

On further examination, this compound has been shown to be an aromatic substance and is in reality a *dichlorotrimethylbenzene*. At the time the work was done, it was not known that phosphorus haloids acted on dihydroresorcins to give aromatic derivatives; the fact has only since been established (*Trans.*, 1902, **81**, 1536; 1903, **83**, 116, 502), moreover as the formulæ of these two substances differ only by two hydrogen atoms, analysis is not of much help in deciding between them.

Dichlorotrimethyldihydrobenzene is produced during the action of phosphorus pentachloride on trimethyldihydroresorcin (*loc. cit.*), and is contained in the liquid boiling at 120—125° under 31 mm. pressure.

The chemical properties of both these substances will be described in detail on a future occasion.

143. "The estimation of hydroxylamine." By H. O. Jones and F. W. Carpenter.

The methods hitherto described for the estimation of hydroxylamine were found to be very untrustworthy in the presence of substances such as neutral metallic salts, although these compounds would not be expected to affect the reactions involved. The following process has been devised, which is free from these objections and is simple and accurate.

Ten to 20 c.c. of the hydroxylamine solution (which should not contain more than 0·5 per cent. of the base) are added to a hot solution of copper potassium carbonate or copper potassium tartrate, which is well stirred during the addition. The mixture is raised to the boiling point, the cuprous oxide at once collected in a Gooch crucible, washed with hot water, and dissolved in ferric sulphate solution in an atmosphere of carbon dioxide, the ferrous salt produced being titrated with potassium permanganate solution as recommended by Wood and Berry (*Proc. Camb. Phil. Soc.*, 1903, **12**, ii, 97). Four mols. of the permanganate correspond with 10 mols. of hydroxylamine.

The foregoing reactions are not affected by the presence of foreign substances provided that these do not reduce the copper solutions, and the method may be applied to mixtures containing sodium, potassium, ammonia, cobalt, nickel, and zinc salts, carbon dioxide, alcohol, acetic acid, and ketoximes.

144. "A study of the isomerism and optical activity of quinquevalent nitrogen compounds." By H. O. Jones.

An attempt has been made to prepare isomerides of quaternary ammonium compounds of the type $N{\cdot}R'R''R_2'''X$. The existence of these isomerides is theoretically possible on any configuration of the nitrogen atom, since it has been proved conclusively by the work of Pope and his colleagues that the configuration of radicles about a quinquevalent nitrogen atom is a stable one giving rise to optical activity. Taking Bischoff's "pyramidal" configuration, which affords the best explanation of the facts at present known, two isomerides are to be expected, one of which should be capable of existing in optically active forms.

Seven compounds of the desired type have been produced (with one exception in two different ways) and their properties studied, but no evidence of isomerism was obtained. The compounds have been examined for optical activity by the fractional crystallisation of the *d*-camphorsulphonate and the *d*-bromocamphorsulphonate from non-hydroxylic solvents; in no case was any resolution effected, so that the compound produced in all cases has a planisymmetric configuration. The absence of isomerism is discussed in the light of Kipping's results on the isomerism of compounds of the type NRH_3X, in which R and X both contain an asymmetric carbon atom.

Optical activity due to an asymmetric nitrogen atom is to be expected in α- and β-substituted pyridinium compounds and in certain tetrahydroquinolinium derivatives. Several of these compounds have been examined by the method already mentioned, but for some unknown reason no resolution could be effected.

d-*Phenylbenzylmethylethylammonium* d-*camphorsulphonate* melts at 181° and the corresponding d-*iodide* at 146—147°; the *platinichloride* of *d*-phenylmethylethylallylammonium *d*-bromocamphorsulphonate melts at 159—160°.

145. "The influence of various substituents on the optical activity of tartramide." By P. F. Frankland and A. Slator.

This paper forms a part of the systematic investigation being made by one of the authors on the connection between the rotation and chemical constitution of optically active molecules. The preparation and properties of seventeen derivatives of tartramide are described, the series including the methyl, ethyl, and benzyl amides, the anilide toluidides (*o*-, *m*-, and *p*-), and α- and β-naphthylamides; the anil and *p*-toluil; the hydrazide and phenylhydrazide; the hydrazones of benzaldehyde, furfuraldehyde, and acetophenone; as well as the *o*-toluidide of diacetyltartaric acid.

In order to avoid errors arising from the possible racemisation of the tartaric acid, the compounds have, in nearly all cases, been prepared by the direct interaction of acid and base, as well as by acting with the base on an ethereal salt of the acid; but, although the latter reaction could generally be made to take place at a lower temperature than the former, no substantial difference in the optical activity of the products was discoverable.

All the compounds were, like tartramide itself, dextrorotatory. The molecular rotation is considerably increased by the introduction of the methyl, ethyl, and benzyl groups, whilst a much greater augmentation is effected by the introduction of the aromatic radicles, the highest rotation being obtained in the case of the β-naphthylamide.

The two imides—tartranil and tartaric *p*-toluil—have much lower rotations than the corresponding diamides—tartranilide and tartaric *p*-toluidide—notwithstanding the cyclic groupings present in the former compounds. Similarly, low rotations have, however, also been found by Walden for malanil and malic β-naphthimide.

The molecular rotation of tartaric hydrazide is very slightly greater than that of tartramide, whilst that of the phenylhydrazide is much less than that of either; but, on the other hand, the hydrazones have very high rotations, a circumstance which is very probably due to the double linking which they contain, this grouping, whether between two atoms of carbon or between carbon and nitrogen, being known to exert a powerful influence on the rotation.

146. "The influence of cyclic radicles on optical activity: tartaric *ar*- and *ac*-tetrahydro-β-naphthylamides, furfurylamide, and piperidide." By P. F. Frankland and E. Ormerod.

The authors describe the preparation and properties of the above compounds. As anticipated, the *ar*-tetrahydro-β-naphthylamide has a molecular rotation, $[M]_D^{20^\circ}$ +840°, of the same order as those of the ordinary aromatic amides of tartaric acid, whilst the rotation of the *ac*-tetrahydro-β-naphthylamide, $[M]_D^{20^\circ}$ +240°, is very much lower, being of the same order as those of the fatty amides: methylamide, $[M]_D^{20^\circ}$ +278°, and ethylamide, +279°.

It has been shown by P. Frankland and F. W. Aston (*Trans.*, 1901, 79, 514) that the rotatory influence of the pyromucyl radicle is very similar to that of the benzoyl and toluyl groups, from which is to be inferred that the furfuran and benzene rings resemble each other in rotatory effect. It would be expected, therefore, that the furfurylamide should have a molecular rotation of the same order as that of the benzylamide; as a matter of fact, they were found to be practically identical, thus:

	$[M]_D^{20^\circ}$.
Tartaric dibenzylamide	+300°
,, difurfurylamide	+300—307°

Tartaric dipiperidide was found to be practically inactive.

147. "The rotatory power of maldiamide, maldi-n-propylamide, and maldibenzylamide." By J. McCrae.

*Maldi-*n*-propylamide* and *maldibenzylamide* were prepared by heating diethyl *l*-malate with *n*-propylamine and benzylamine respectively. The propylamide melts at 125·5° and the benzylamide at 155·5°.

The specific rotations are: in acetic acid ($c = 4·7$ to 5), maldiamide, −45·2°; maldi-*n*-propylamide, −47°; maldibenzylamide, −20·2°; in pyridine, maldiamide ($c = 2$), $-57{\cdot}7°$; maldi-n-propylamide, $-41{\cdot}9°$; maldibenzylamide, $-32{\cdot}4°$.

By comparing these results with those obtained by Guye and Babel and by Walden for the corresponding anilide and toluidides, it is seen that the effect produced on the rotatory power by the introduction of benzyl groups into maldiamide is similar to that caused by introducing fatty alkyl groups, but is different from that brought about by replacing hydrogen of the amino-groups by aryl radicles.

148. "Further experiments with phosphorus sesquisulphide."

By E. G. Clayton.

In a previous communication (*Proc.*, 1902, 129), it was shown that commercial phosphorus sesquisulphide of good quality had been found to give no reaction with Mitscherlich's test. With the object of studying under what conditions, oxidation, or a similar change, is promoted, and whether, by keeping, this compound acquires the property of yielding a luminous vapour when distilled with dilute sulphuric acid, the author has exposed specimens, which had previously given negative results, for various periods under different conditions, the products being then subjected to Mitscherlich's test.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.		Observation.
				grms.	c.c.	
1	Dry air.	Tightly corked, wide-mouthed bottle, about 90 c.c. capacity.	6	10	50	Negative result. No phosphorescence at any stage of the experiment, or in any portion of the apparatus.
2	Air mixed with acetic acid and water-vapour.	Bell-jar, 4 litres' capacity.	6	20	100	Result as above.
3	Somewhat damp air.	Loosely stoppered, wide-mouthed bottle, 300 c.c. capacity.	6	20	100	When 35 c.c. had distilled, a faint luminosity appeared on cooling in the upper coils of the spiral condenser and in the flask.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.		Observation.
				grms.	c.c.	
4	Air saturated with moisture.*	Glass shade, 21 litres' capacity.	6	5	32	Strong phosphorescence in flask, connecting tube, and coils of condenser. On cooling, a vertical stream of luminous vapour descended into the flask.
5	Air saturated with water-vapour.*	Bell-jar, 4 litres' capacity.	1	10	50	Similar reaction, but less marked.
6	Atmosphere mingled with ammonia, carbon dioxide, and water-vapour.	Bell-jar, 4 litres' capacity.	6	20	100	Excessively faint phosphorescence in upper coils, none in flask.
7	Air impregnated with hydrochloric acid.	Glass shade, 21 litres' capacity.	6	20	100	After 30 c.c. had distilled, phosphorescence appeared in upper coils and connecting tube, none in flask.
8	Air over sulphuric acid. [The acid became brown and diluted in the course of the experiment, the air being evidently moist.]	Glass shade, 3·75 litres' capacity.	6	20	100	Towards the end of the experiment, a feeble glow appeared, visible in the upper coils of the condenser only.
9	Atmosphere impregnated with nitrogen oxides.	Glass shade, 21 litres' capacity.	2	10	50	Before 5 c.c. had distilled over, a very strong phosphorescence appeared on cooling, and a vertical stream of light descended into the flask, the interior of which became luminous for several minutes.

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* In these cases, a garlic odour was perceptible when the glass vessels were removed.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.	Observation.
				grams c.c.	
10	Air of average humidity.	Beaker, 300 c.c. capacity.	2¾	20 100	When 30 c.c. had distilled, a distinct but slight luminosity was visible in the upper coils and connecting tube, although not in the flask.
11	Air of average humidity.	Glass shade, 21 litres' capacity.	2¾	20 100	After 40 c.c. had passed over, traces of phosphorescence were noticed in tube and coils, but none in flask.

Experiments 9, 10, and 11 were made at a later date than the rest, consequently with a sample of sesquisulphide which had already been kept in the laboratory for a longer period. The last two experiments were made with the view of investigating the influence, if any, of the size of the vessel, but the results were not markedly different.

The temperature of the laboratory, of course, fluctuated considerably, but similar variations were experienced by samples exposed for the same periods.

From the results of these experiments, in which the author was assisted by Mr. G. N. Bacon, it is evident that good commercial phosphorus sesquisulphide undergoes little change if preserved in air of average dryness in nearly filled, well-closed vessels, but that the progress of the oxidation is appreciable in a damp atmosphere or in imperfectly closed vessels; this action takes place particularly rapidly in air saturated with moisture, and perhaps to the greatest extent in the presence of acid vapours, especially such as nitrogen peroxide.

Comparative experiments were made with yellow phosphorus, from which a luminous vapour passed over almost as soon as distillation began. With phosphorus sesquisulphide, on the other hand, the phosphorescence in most cases was seen only after the pressure had been diminished by the removal of the lamp, and after a considerable proportion of the liquid had distilled over. The author's experiments confirm J. Mai and F. Schaffer's observation (*Ber.*, 1903, **36**, 870; also *J. Soc. Chem. Ind.*, 1903, **22**, 511) that the glow differs from that of yellow phosphorus.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 7th.

At the next ordinary meeting, on **Wednesday**, November 18th, 1903, at **5.30** p.m., the following papers will be communicated:—

"Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its enolic form." By P. Remfrey, and J. F. Thorpe.

"The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic." By W. T. Cooke.

"The union of carbon monoxide and oxygen and the drying of gases by cooling." By A. F. Girvan.

"Note on a double chloride of molybdenum and potassium." By G. G. Henderson.

"Simplification of Zeisel's method for the determination of methoxy- and ethoxy-groups." By W. H. Perkin.

"The action of benzamidine on olefine β-diketones." By S. Ruhemann.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 271.

Wednesday, November 18th, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.

Allan Baguley, B.Sc., University College, Bangor.
James Rocheid Forrest, D.P.H., Kirkee, near Poona, India.
Harry James Glover, 33, Albert Road, Stroud Green, N.
John Augustus Goodson, 19, Darnley Road, Hackney, N.E.
Alfred Henry Hoit, 4, Montgomerie Road, Southsea.
Bernard Middleditch, B.A., Woodcroft, Harrow-on-the-Hill.
Bertram Prentice, Ph.D., D.Sc., Royal Technical Institute, Salford.
Frederick Henry Streatfeild, 9, Crescent Road, South Tottenham, N.
William Wood Underhill, 10, Hartham Road, Holloway, N.
Francis Langston Watt, 111, Lauderdale Mansions, Maida Vale, W.

The President announced that the Librarian had reported that the following books were missing from the Library:

Lunge, G. A treatise on the distillation of coal-tar and ammoniacal liquor and the separation from them of valuable products. London 1882.

Ganot, A. Elementary treatise on physics. Trans. by E. Atkinson. 6th edition. London 1873.

Muir, M. M. P. The alchemical essence and the chemical element. An episode in the quest of the unchanging. London 1894.

Pamphlets, Vol. 6.

Centralblatt für Bakteriologie. Bd. 23.

He would be glad if Fellows would do what they could to assist the Librarian in recovering these missing volumes.

Of the following papers, those marked * were read:

*149. "The union of carbon monoxide and oxygen and the drying of gases by cooling." By A. F. Girvan.

The following experiments were made in order to investigate whether the drying of an explosive mixture of carbon monoxide and oxygen by exposure to low temperatures was sufficient to prevent chemical union taking place when the gas was sparked after it had regained the ordinary temperature.

A small glass gas-holder containing the explosive mixture was sealed to the following apparatus arranged in series: (1) a small bubbler containing water, (2) a stopcock, (3) a vertical glass spiral, (4) a glass tube, one centimetre in diameter, furnished with platinum terminals with a spark gap of about 4 mm., (5) a stopcock, (6) a Töpler pump. Stopcocks were sealed as side-tubes between (2) and (3) and between (5) and (6). The carbon monoxide was prepared by the interaction of "pure" sulphuric and formic acids, the oxygen being obtained by heating potassium permanganate; the gases were collected and stored over water and the proportion was correct to within 1 per cent.

A slow current of air was aspirated through the apparatus by means of the side-taps, while the whole apparatus between them was thoroughly heated. The spiral was then surrounded by a freezing mixture and the tube between it and the pump was heated to the softening point of the glass. After some time, the current of air was stopped and the heating discontinued. The apparatus was then completely exhausted as far as the bubbler by means of the Töpler pump and the explosive mixture slowly admitted at the rate of one bubble per second. When the gas in the apparatus was under atmospheric pressure, the tap of the gas-holder was closed and sparks from an induction coil were passed through the explosion tube in which the gas was now at the temperature of the atmosphere.

In the first experiments, where liquid air was used, care had to be taken that this cooling agent was not too fresh, as it was then sufficiently cold to liquefy the explosive mixture. No explosion took place on passing sparks from an induction coil which, at the same time, was giving 12 mm. sparks in the air, although the sparks in the gaseous mixture were usually surrounded with a little ball of blue flame. When the glass spiral was allowed to regain the ordinary temperature, the moisture which had been condensed in the spiral slowly diffused into the explosion-tube and a single spark exploded the mixture with a sharp report.

On sparking the mixed gases which had been cooled in a mixture of solid carbon dioxide and alcohol (−80°), there was no explosion, and the little ball of flame round the sparks had much the same appearance as when the gases had been dried at −180°, but when the glass spiral had acquired the ordinary temperature, a single spark produced a sharp explosion. When the gaseous mixture had been cooled to −15° and allowed to regain the ordinary temperature, the first spark always caused an explosion, but this did not occur after cooling below −50°. When dried between −50° and −35°, faint sparks did not, as a rule, cause the mixture to explode, although powerful sparks always produced this effect. The freezing mixture employed was either liquid air or solid carbon dioxide in alcohol, and when kept in a vacuum-vessel its temperature rose only about half a degree per minute, even when a current of air was passing through the spiral.

A single powerful spark, when passed through the mixture (after drying between −50° and −35°), frequently produced no effect, whereas an explosion always occurred on passing the second or third spark.

The explosion produced by powerful sparks in the gases dried between −50° and −35° is of a very different character from that obtained with the wet gases; the latter is very quick and violent and gives a metallic click, but the former takes place quietly, and the explosive wave often travels quite slowly along the tube (compare Dixon, *Phil. Trans.*, 1884, **175**, II, 630). The wave proceeding from these feeble explosions always stopped directly it reached the cold part of the spiral, and the gas in this part of the apparatus was found to be unaltered, but when the gas was moist and the spiral at the ordinary temperature, the explosion passed to the furthest part of the apparatus.

The platinum terminals were now replaced by (1) a silver wire, (2) a gold wire: each of these was heated to redness and then fused by an electric current, without causing any visible union in the explosive mixture, which had been dried at about −80°. In order to find out whether platinum would act catalytically on the dried or partly dried gases (compare Dixon, *loc. cit.*), a tube, in which the platinum terminals were replaced by a coil of platinum wire, was sealed in place of the sparking-tube and the apparatus dried as before. The explosive mixture was then allowed to enter through the spiral, which was kept at various temperatures.

With a mixture dried at about −35°, the platinum acted catalytically, and in becoming heated to redness brought about a quiet and feeble explosion. When, however, the mixture was dried at temperatures between −80° and −180°, the platinum still acted catalytically and glowed for several seconds, but there was no other sign of chemical action. After the glowing had ceased, the coil was kept at a white heat for several minutes by means of an electric current, and the gas was then pumped off and collected. About one-eighth of the gaseous mixture was absorbed in caustic potash solution and the residue was still explosive, showing that combination was far from complete.

At Sir William Ramsay's suggestion, the author calculated the amount of moisture present in the mixture after cooling (compare *Trans*, 1886, **49**, 46), the following data being employed:

Temperatures	– 61°	– 56·5°	– 51°	– 45°	– 36°
Pressures in mm.	0·008	0·01	50·029	0·052	0·160

When the vapour pressure of the water is less than about 0·03 mm., as is the case with the mixture after cooling at – 50°, the gases will not explode. When the vapour pressure is less than about 0·16 mm., the explosion is very feeble.

In the first case, the amount of water vapour present is about one part in twenty-four thousand by volume, and in the second, one part in five thousand. At – 61°, the amount of water vapour would be about one part in a hundred thousand of gas.

It would appear then that the mixture will not explode when sparked at the ordinary temperature if there is less than one mol. of water vapour to twenty-four thousand mols. of the gas.

These figures must, however, be taken as being only approximate, since below – 50° the vapour pressure of ice falls to half its value for a decrease of about 7°, and, moreover, it is not known whether the glass of the apparatus exerts any drying effect on the contained gas.

DISCUSSION.

Sir W. RAMSAY pointed out the interest of Mr. Girvan's experiments in connection with surface-layers on glass. The water-vapour in contact with the water-layer on the glass must have a vapour-pressure comparable with, or less than, the vapour-pressure in contact with ice at – 185°. This film is removed on heating the glass in a current of dry air, and is not removed when the mixed gases, dried at – 60°, are allowed to enter the dried tube. Such questions are of very great interest from the standpoint of molecular physics, and Mr. Girvan, he knew, hoped to attack these and similar problems at an early opportunity.

Dr. SCOTT suggested that the water which adhered to the glass might be there not as a gaseous layer but either as a hydrated silicate or in combination with alkali.

*150. "Simplification of Zeisel's method of methoxyl and ethoxyl determinations." By W. H. Perkin.

In this process, a long-necked distilling flask was employed without any other condensing arrangement, the tube for the current of carbon dioxide being passed down the neck to within a short distance of the hydriodic acid. It was eventually found that as long as the temperature of the glycerin bath was so adjusted that actual distillation of the acid into the delivery tube did not take place, no appreciable quantity of hydrogen iodide passed forward into the silver nitrate flasks. The acid used boiled at 126° and had a sp. gr. of 1·68 approximately.

The following arrangement has been found to prevent the silver nitrate solution from being sucked back into the distilling flask after a sudden ebullition of hydriodic acid. Two small flasks are used as usual, but the tube conducting the carbon dioxide and methyl iodide vapour, instead of passing into the silver solution, is kept some distance above its surface. The flasks are then connected with a siphon tube, one arm of which reaches to within a short distance of the solution in the first flask, whilst the other arm dips a little below the surface in the second. By this arrangement, the methyl iodide is chiefly absorbed by the surface of the silver solution, but any escaping is caught as it bubbles through the second quantity, then, if any such drawing back takes place, some of the solution passes into the first flask, and as soon as the pressure increases is forced back again into the second.

This method of determining the methoxyl group gave very good numbers and can be used equally well for determining the ethoxyl group, but in this case the numbers are not usually so accurate, being generally a little less than the calculated quantity.

*151. "The rusting of iron. Part II." By G. T. Moody.

The author has further investigated the causes of the rusting of iron, more particularly with reference to the influence of soluble substances, and finds that the salts of strong acids, such as sodium chloride and sulphate, potassium sulphate, ammonium sulphate, magnesium chloride and sulphate, calcium chloride and sulphate, and potassium chlorate have no retarding influence on rusting. These salts do not combine with and are not decomposed by carbonic acid. Compounds which inhibit rusting may be divided into two classes. The first contains substances having an alkaline reaction, such as sodium carbonate, hydroxide, phosphate and borate, ammonium carbonate, and barium and calcium hydroxides, all of which directly absorb and combine with carbonic acid. The second class includes salts of weak acids, such as potassium and sodium nitrites, sodium formate, sodium acetate, potassium ferrocyanide and chromate. These salts are all decomposed by carbonic acid. Sodium nitrite solution, for example, after exposure to air becomes alkaline and contains sodium carbonate. A solution of 10 grams of the nitrite, through which a slow stream of carbon dioxide was passed for 9 days, contained 1·585 grams of sodium carbonate. Similarly, potassium ferrocyanide solution, when exposed to air, slowly evolves hydrogen cyanide and becomes alkaline. This change occurs more rapidly when carbon dioxide is passed through the solution, the escaping gas having the odour of hydrogen cyanide and precipitating silver cyanide from a solution of silver nitrate. Potassium ferricyanide is a salt of a weak acid which exceptionally does not appear to retard rusting. This substance is, however, reduced by iron whether its solution be exposed to air or not, the metal becoming covered in either case with a mass of insoluble, greenish-blue cyanide.

It may therefore be concluded that the influence of any particular compound on the atmospheric rusting of iron depends on its behaviour towards carbonic acid, and that only those substances which combine with or are decomposed by carbonic acid inhibit rusting.

Dunstan has stated (*Proceedings of the Royal Artillery Institution*, 1899, **5**, 26, and this vol., p. 150) that the metals which rust in air are oxidised by hydrogen peroxide, whilst those which are not oxidised by this reagent do not rust in air. Iron, zinc, and lead are cited as examples of the first class, and copper, silver, and nickel as types of the second. It is noteworthy that iron and zinc rapidly decompose aqueous carbonic acid, whilst copper, silver, and nickel are indifferent to the acid. Having regard to this, and also to the fact that Giorgis (*Gazzetta*, 1891, **21**, 510) has shown that hydrogen peroxide, when carefully freed from carbon dioxide, is practically without action on magnesium, it appeared probable that iron would not be oxidised by pure hydrogen peroxide. The author has investigated this question by leaving a specimen of distilled hydrogen peroxide in contact with iron for fourteen days. No oxidation of the iron was observed, but on adding to a further portion of the pure peroxide containing iron a drop of hydrochloric acid or a solution of carbon dioxide, hydrated ferric oxide was formed.

In the light of the experiments described, the aërial rusting of iron cannot be attributed to hydrogen peroxide, but must be regarded as a change involving the interaction of iron and acid and subsequent formation of rust by the oxidation of ferrous salt.

DISCUSSION.

Dr. RIDEAL remarked that Müntz had shown (*Compt. rend.*, 1891, 112, 1142) that calcium nitrite in sterilised soil gave off nitrous acid rapidly in presence of carbonic acid, and that he had noticed this reaction in bacterial sewage filters.

Mr. W. A. DAVIS pointed out that the decomposition brought about in aqueous solutions of sodium nitrite and potassium ferrocyanide, although at first sight surprising, was a necessary consequence of the principle of mass action. As both nitrous and hydrocyanic acids are volatile, the conversion of their salts into carbonates by an excess of carbonic acid should be complete after a sufficient interval of time.

Dr. MOODY, in reply, said that the sodium nitrite used, which was a well-crystallised specimen, having a high degree of purity and quite free from carbonate, was so sensitive to carbon dioxide that the gas, after passing through the solution, immediately reacted with potassium iodide and starch solution.

152. "Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its sodium derivative." By F. G. P. Remfry and J. F. Thorpe.

When ethyl sodiocyanoacetate is heated in alcoholic solution for 2 hours at 100° with a molecular proportion of ethyl cyanoacetate, a 70 per cent. yield of the *compound*, $CN{\cdot}CH_2{\cdot}HC(OEt){\cdot}O{\cdot}CH(CN){\cdot}CO_2Et$, is produced, which crystallises from dilute alcohol in long needles, melts at 53°, and distils with partial decomposition at 235° under 20 mm. pressure. On boiling with sodium carbonate solution, this substance dissolves, and, on acidifying the solution, the *acid*, $CN{\cdot}CH_2{\cdot}HC(OEt){\cdot}O{\cdot}CH(CN){\cdot}CO_2H$, separates; it crystallises from water in large prisms and melts at 142° with evolution of carbon dioxide, being converted into a *substance* having the formula $(C_7H_{10}O_2N_2)_x$, which crystallises from glacial acid in small, yellow needles having no definite melting point; on distillation, it gives rise to the *compound* $CN{\cdot}CH_2{\cdot}HC(OEt){\cdot}O{\cdot}CH_2{\cdot}CN$, separating from absolute alcohol in large prisms melting at 181° and boiling at 208° under 25 mm. pressure. The same substance is produced quantitatively if the ammonium salt of the acid melting at 142° is distilled under diminished pressure.

Concentrated aqueous potash hydrolyses the substances melting at 53° and 142°, forming malonic acid; the compound melting at 181°, when similarly treated, yields malonic and acetic acids.

When the sodium compound of the condensation product is heated directly with methyl iodide, the *methyl* compound,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2Et,$$

is produced; it crystallises from dilute alcohol in small prisms, melts at 63°, and boils without decomposition at 220° under 20 mm. pressure. With sodium carbonate, the *acid*,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2H,$$

is produced; it crystallises from water in glistening plates, melts at 145° with evolution of carbon dioxide, and becomes converted into a compound, $(C_8H_{10}O_2N_2)_x$, having no definite melting point, but which, on distillation, is converted into the *substance*,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH_2\cdot CN,$$

crystallising from absolute alcohol in small prisms and melting at 121°. The same substance is produced when the acid melting at 145° is boiled for some time with sodium carbonate solution, or when its ammonium salt is distilled. The substances melting at 63° and at 145° give, on hydrolysis with aqueous caustic potash, malonic and methylmalonic acids; the compound melting at 121° yields methylmalonic and acetic acids.

When the sodium compound of the condensation product is treated directly with ethyl iodide, it is converted into the *ethyl* compound, $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2Et$, which crystallises from dilute alcohol in prisms, melts at 68°, and boils without decomposition at 215° under 20 mm. pressure. With sodium carbonate, it yields the *acid*, $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2H$, which crystallises from water and melts at 153° with evolution of carbon dioxide and becomes converted into an infusible substance having the formula $(C_9H_{14}O_2N_2)_x$. The latter compound, on distillation, gives rise to the substance $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH_2\cdot CN$, which crystallises from absolute alcohol in small plates melting at 115°.

Complete hydrolysis of the above-mentioned substances melting at 68° and at 153° gives rise to malonic and ethylmalonic acids; the compound melting at 115° yields ethylmalonic and acetic acids.

When the substance melting at 53° is treated with excess of sodium ethoxide and methyl iodide, it is converted into the *trimethyl* compound, $CN\cdot C(Me)_2\cdot HC(OEt)\cdot O\cdot CMe(CN)\cdot CO_2Et$, which crystallises from dilute alcohol in small needles and melts at 120°. Complete hydrolysis of this substance with aqueous potash gives rise to methylmalonic and dimethylmalonic acids.

The action of acidic hydrolytic agents on these substances, and the condition governing the formation of similar condensation products from substituted ethyl cyanoacetates, is under investigation.

153. "The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic." By W. T. Cooke.

Engel (*Compt. rend.*, 1883, 96, 1314) states that amorphous arsenic is unaltered in moist air, whilst the crystalline modification oxidises rapidly. The author's experiments were made with the view of ascertaining: (1) whether water alone had any action on either variety, (2) whether the action, if any, was increased by the presence of caustic soda, (3) and whether, in the presence of air, the crystalline variety dissolved to a greater extent in caustic soda solution than in water.

Amorphous Arsenic.—The operations were carried out entirely in an inert atmosphere, the gas employed being either carbon dioxide or hydrogen, according as water or caustic soda solution was used. The main part of the apparatus consisted of two boiling tubes provided with condensers and also with tubes for the introduction of the gas. Hydrogen arsenide was passed into one carefully dried boiling tube, so that arsenic was deposited on warming. The water or caustic soda solution contained in the other tube was freed from air by boiling and by passing through it a current of hydrogen or carbon dioxide. The pressure of the gas in the apparatus was then used to force over the solution into the tube containing the arsenic, after any remaining hydrogen arsenide had been expelled. The solution could then be boiled in contact with the arsenic for any desired time, and finally drawn off through an asbestos filter. The arsenic in the filtrate was usually estimated by titrating with iodine solution.

The following results were obtained using 125 c.c. of distilled water:

Time of boiling in hours	2·5	1·5	2·5	8	4	6
Weight of dissolved arsenic in grams...	0·0020	0·0009	0·0004	0·0034	0·0013	0·0016

In the absence of air, the action of water on amorphous arsenic is thus seen to be very slight. When air was aspirated through the boiling water for 6½ hours in contact with the amorphous arsenic, only 0·0010 gram of the element was dissolved, hence the presence of air has no effect.

In the absence of air, the effect of dilute caustic soda solutions was slightly greater than that of water, and the action increases with the concentration of the alkali. Moreover, the action is not influenced by the presence of air.

In the absence of air.			In the presence of air.		
Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.	Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.
N/100	1·5	0·0022	*N*/100	2·75	0·0014
	5·3	0·0026		6·0	0·0014
N/50	3·5	0·0021	*N*/50	2·5	0·0038
	6·0	0·0020		6·0	0·0010
N/25	6·0	0·0038	*N*/25	6·0	0·0046
				6·0	0·0014

Crystalline Arsenic.—In this case, the boiling tube was provided with a side tubulure, through which the crystalline arsenic could be introduced. The arsenic was powdered and introduced into the apparatus as quickly as possible on account of the readiness with which the finely divided element undergoes oxidation. The volume of liquid used was 50 c.c. When distilled water was used and air excluded, about 0·0025 gram of arsenic dissolved in 1¼ to 1½ hours.

With distilled water in presence of air, about 0·0233 gram of arsenic dissolved in 1¼ hours. Hence the presence of air greatly increases the action in the case of the crystalline modification of the element. The following results obtained with caustic soda show that the alkali does not materially increase the action.

In the absence of air.			In the presence of air.		
Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.	Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.
N/100	6	0·0025	*N*/100	6	0·0712
N/50	6	0·0016	*N*/50	6	0·0797
N/25	6	0·0030	*N*/25	6	0·0267
	6	0·0017			

By estimating the dissolved arsenic by the iodometric and gravimetric methods, it was found to be entirely in the form of arsenious acid.

The results seem to show that water either alone or in the presence of caustic soda has practically no action on arsenic. In the presence of air, however, direct oxidation takes place. If water is concerned in the oxidation, the formation of hydrogen arsenide might be anticipated: $2As + 3H_2O = As_2O_3 + 6H$, $2As + 6H = 2AsH_3$; but this gas was never found in the foregoing experiments.

Th. Panzer (*Chem. Centr.*, 1903, ii, 821), has also shown that the oxidation of arsenic in moist air is due not to the decomposition of water, but to the intervention of free oxygen.

154. "Note on a double chloride of molybdenum and potassium." By G. G. Henderson.

According to Berzelius (*Poggendorff's Annalen*, 1826, 6, 331, 339; 7, 261), a chloride of molybdenum and potassium is obtained when the black liquid produced by the action of [potassium amalgam on a solution of molybdenum pentachloride is evaporated to the crystallising point, and is described as a black, efflorescent salt, which, when redissolved in water, leaves a black powder, probably a basic salt.

A definite *double chloride* of molybdenum and potassium, having the formula $3KCl,MoCl_3,2H_2O$, has been prepared in the following manner: potassium amalgam was added, in small quantities at a time, to a solution of molybdic acid in excess of hydrochloric acid until the liquid had acquired a purple-black colour. The solution was concentrated and saturated with gaseous hydrochloric acid, when successive crops of crystals were obtained; the first was composed of potassium chloride alone, the second of a mixture of potassium chloride with red crystals of the double salt, and the third of the double salt alone. The red crystals were collected, washed with fuming hydrochloric acid, dried by pressure between folds of filter paper, and analysed with the following result:

Found: $Mo = 21{\cdot}39$; $Cl = 45{\cdot}46$; $H_2O = 7{\cdot}47$.
$3KCl,MoCl_3,2H_2O$ requires $Mo = 20{\cdot}92$; $Cl = 45{\cdot}80$; $H_2O = 7{\cdot}80$ per cent.

The new salt, which crystallises in garnet-red prisms, is fairly easily soluble in cold water, without any apparent decomposition, giving a deep red solution. In the dry state, the salt is quite stable, but it decomposes in aqueous solution, slowly in the cold, but quickly on boiling; this decomposition is prevented by the presence of hydrochloric acid. The salt is dissolved, to a small extent, by concentrated hydrochloric acid, which then acquires a deep red colour.

When a solution of molybdic acid in hydrochloric acid was reduced in a similar manner by sodium amalgam, a few red crystals were obtained, very similar in appearance to those of the potassium salt; they probably consisted of the corresponding double chloride of molybdenum and sodium, but were not analysed on account of the difficulty of freeing them from admixed sodium chloride.

An attempt was made to prepare the potassium salt by adding potassium chloride to a concentrated solution of molybdic hydroxide, $Mo(OH)_3$, in hydrochloric acid, and subsequent saturation of the liquid with gaseous hydrochloric acid, but in this case the brilliant, green crystals of the compound $2KCl,MoOCl_3,2H_2O$, which has been prepared previously, but in a different manner, by Nordenskjöld (*Ber.*, 1901, **34**, 1572), were produced instead of the expected double chloride. It was found that the same green crystals could be prepared by the action of potassium amalgam on a solution of molybdic acid in hydrochloric acid, if the potassium was added in smaller quantity than is necessary for the production of the red double chloride, and also that the green salt could be converted into the red salt by reducing its hydrochloric acid solution with potassium amalgam.

155. "The action of benzamidine on olefinic β-diketones."

By S. Ruhemann.

The author showed that hydrogen chloride reacts with a mixture of *m*-nitrobenzaldehyde and a β-diketone to form a *m*-nitrobenzylidenediketone, instead of giving rise to the additive product. Thus, *m*-nitrobenzaldehyde and acetylacetone furnish *m*-nitrobenzylideneacetylacetone, $CAc_2{:}CH\cdot C_6H_4\cdot NO_2$, melting at 101—102°. The yield of *m*-nitrobenzylidenebenzoylacetone, $PhCO\cdot CAc{:}CH\cdot C_6H_4\cdot NO_2$ (m. p. 111—112°), is very small owing to the ease with which it is decomposed by acids. One of the products of the decomposition which has been isolated is *m*-nitrobenzylideneacetophenone, $COPh\cdot CH{:}CH\cdot C_6H_4\cdot NO_2$ (m. p. 145°).

m-Nitrobenzylidene-β-diketones are also produced by the action of piperidine on the dry mixture of the aldehyde and the diketone. But in alcoholic solution, the saturated tetraketone is formed, such as *m*-nitrobenzylidenebisbenzoylacetone, $NO_2\cdot C_6H_4\cdot CH(CAc\cdot COPh)_2$ (m. p. 229—230°).

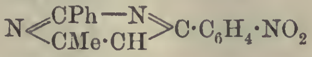
Benzamidine reacts with benzylidenebenzoylacetone,

$$PhCO\cdot CAc{:}CH\cdot Ph,$$

at the ordinary temperature to form an additive compound (m. p. 132°), the constitution of which is $NH{:}CPh\cdot NH\cdot CPh(OH)\cdot CAc{:}CHPh$, because the compound is decomposed by dilute hydrochloric acid, giving rise to dibenzamide. Similar additive products with benzamidine are formed from the other olefinic β-diketones; these, however, are changed when their alcoholic solutions are heated on the water-bath. Thus, sodium ethoxide and benzylideneacetylacetone react with benzamidine at 100° as follows: $CAc_2{:}CHPh + CPh(NH_2){:}NH + C_2H_6O = C_{17}H_{16}N_2 + MeCO_2Et + H_2O$.

The compound, $C_{17}H_{16}N_2$ (m. p. 149—150°), is most probably dihydrodiphenylmethylpyrimidine,
$CHMe{<}{\begin{smallmatrix}CH{:}CPh\\ N{=}CPh\end{smallmatrix}}{>}NH$.

Benzamidine and *m*-nitrobenzylideneacetylacetone interact differently, since *m*-nitrophenylphenylmethylpyrimidine,



$$N{<}{\begin{smallmatrix}CPh—N\\ CMe{\cdot}CH\end{smallmatrix}}{>}C{\cdot}C_6H_4{\cdot}NO_2$$

(m. p. 137—138°), is formed, instead of the corresponding dihydropyrimidine. The olefinic monoketone, benzylidenedesoxybenzoin, $COPh{\cdot}CPh{:}CHPh$, does not condense with benzamidine, and the action of hydrogen chloride on the mixture of *m*-nitrobenzaldehyde and desoxybenzoin proceeds in the same way as when benzaldehyde is used, and yields $COPh{\cdot}CHPh{\cdot}CHCl{\cdot}C_6H_4{\cdot}NO_2$ (m. p. 166—167°).

156. "Dissociation constants of trimethylenecarboxylic acids." By W. A. Bone and C. H. G. Sprankling.

In connection with the work on methylenedimethylsuccinic acid, it became necessary to determine the dissociation constants of some trimethylenedicarboxylic acids, since no data with respect to them were available. The following numbers were obtained:

	$K_{25°}$.		$K_{25°}$.
Trimethylenecarboxylic acid	0·00171	*cis*-Trimethylene-1:2-dicarboxylic acid ...	0·042
Trimethylene-1:1-dicarboxylic acid ...	2·08	*trans*-Trimethylene-1:2-dicarboxylic acid	0·0215

A comparison of these values with those of the corresponding open chain saturated acids containing two additional hydrogen atoms indicates that the formation of a trimethylene ring increases the constant, this effect being particularly noticeable in the succinic series.

157. "The elimination of hydrogen bromide from bromo-*gem*-dimethylsuccinic acid and from bromotrimethylsuccinic anhydride." By W. A. Bone and H. Henstock.

*Bromo-*gem*-dimethylsuccinic acid* (m. p. 140°) is readily prepared by heating *gem*-dimethylsuccinic acid with the calculated quantity of dry bromine in sealed tubes at 130—140°; when heated with redistilled diethyl aniline at 130°, carbon dioxide is freely evolved, hydrogen bromide is eliminated, and *$\alpha\alpha_1\alpha_1$-tetramethyldihydromuconic acid* is formed in the following manner: $2CO_2H{\cdot}CMe_2{\cdot}CHBr{\cdot}CO_2H = CO_2H{\cdot}CMe_2{\cdot}CH{:}CH{\cdot}CMe_2{\cdot}CO_2H + 2HBr + 2CO_2$. The new acid is obtained in well-defined, transparent, prismatic forms melting at 70°; it is extremely soluble in the ordinary organic solvents with the exception of light petroleum; its aqueous solutions immediately decolorise alkaline permanganate with formation of the *dihydroxy-acid*, $CO_2H{\cdot}CMe_2{\cdot}CH(OH){\cdot}CH(OH){\cdot}CMe_2{\cdot}CO_2H$, which melts at 129—130°. The dissociation constant of the tetrahydromuconic acid is $K_{25^\circ} = 0{\cdot}001684$. The acid distils unchanged under the ordinary pressure, but when boiled with acetic anhydride it yields its own liquid anhydride.

In view of Paolini's observation (*Gazzetta*, 1900, 30, ii, 497) that ethyl dimethyltrimethylenedicarboxylate is the product of the action of phosphorus pentachloride upon ethyl hydroxytrimethylsuccinate, the authors have repeated the work of Bone and Sprankling on the action of diethylaniline on bromotrimethylsuccinic anhydride (*Trans.*, 1902, 81, 50), and by a study of the physical properties of the resultant acid, $C_7H_{10}O_4$, have fully confirmed the previous conclusion that it is *methylenedimethylsuccinic acid*, $CH_2{:}C(CO_2H){\cdot}CMe_2{\cdot}CO_2H$. This acid melts at 142°, has a dissociation constant, $K_{25^\circ} = 0{\cdot}01597$, and gives an insoluble calcium salt. Determinations of the refractive power and magnetic rotation of diethyl methylenedimethylsuccinate, made by Dr. W. H. Perkin, sen., fully support the argument in favour of the unsaturated character as against the "trimethylene" configuration of the foregoing acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Hellot, Jean. Färbekunst oder Unterricht, Wolle und wollene Zeuge zu färben; nebst Vorschriften wegen der Prüfungen durch Absieden. Aus dem französischen übersetzt von Abraham Gotthelf Kästner. Zwente Auflage, welcher eine Nachricht von der Seidenfärberen. Altenburg 1765.

From Major-General J. Waterhouse, I.S.C.

Holleman, A. F. Textbook of Organic Chemistry, translated from the second Dutch edition by A. J. Walker, assisted by O. E. Mott. New York 1903.

From the Publishers,

Meyer, Dr. H. Determination of Radicles in Carbon Compounds. Authorised translation by J. Bishop Tingle. 2nd edition. ill. New York 1903. From the Translator.

II. *By Purchase.*

Abegg, R. Die Theorie der elektrolytischen Dissociation. Stuttgart 1903.

Aschan, Ossian. Die Konstitution des Kamphers und seiner wichtigsten Derivate. Braunschweig 1903.

Baccioni, G. B. Dall 'Alchimia alla Chimica. Torino 1903.

Crookes, W. On the manufacture of beetroot sugar in England and Ireland. ill. London 1870.

Deutschen Landwirtschafts-Gesellschaft Arbeiten.

Heft 80. Die Düngung mit schwefelsaurem Ammoniak und organischen Stickstoffdüngern im Vergleich zum Chilisalpeter. Berlin 1903.

—— Heft 81. Untersuchungen über den Wert des neuen 40 prozent.Kalidüngesalzes gegenüber dem Kainit. Berlin 1903.

Ferchland, P. Grundriss der reinen und angewandten Elektrochemie. ill. Halle 1903.

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Garola, C. V. Engrais. Paris 1903.

Gauss, Carl Friederich. Allgemeine Grundlagen einer Theorie der Gestalt von Flüssigkeiten im Zustand des Gleichgewichts. Ueebersetzt von R. H. Weber. Hrsg. von H. Weber (Ostwald's *Klassiker*, No. 135.) Leipzig 1903.

Grandeau, Louis. Valeur et rôle alimentaires du sucre chez l'homme et chez les animaux. Paris 1903.

Guldberg, C. M. Thermodynamische Abhandlungen über Molekulartheorie und chemische Gleichgewichte 1867—1872. Ubersetzt und hrsg. von R. Abegg. (Ostwald's *Klassiker*, No. 139.) Leipzig 1903.

Haller, Albin. Les industries chimiques et pharmaceutiques. 2 Tome. ill. Paris 1903.

Hassack, P. Gärungs-Essig. ill. Wien 1904.

Horstmann, A. Abhandlungen zur Thermodynamik chemischer Vorgänge. Hrsg. von J. H. van't Hoff (Ostwald's *Klassiker*, No. 137.) Leipzig 1903.

Jünemann, Friedrich. Die Brikett-Industrie und die Brennmaterialien. Wien 1903.

König, J. Chemie der menschlichen Nahrungs-und Genussmittel. Vol. I, Chemische Zusammensetzung der menschlichen Nahrungs-und

Genussmittel. Nach vorhandenen Analysen mit Angabe der Quellen zusammengestellt. 4 Aufl. Hrsg. von A. Bömer. Berlin 1903.

Labonne, Henry. Formulaire pratique des parfums et des fards. ill. Paris 1903.

Lodge, Oliver. Modern Views on Matter. (Romanes Lecture 1903.) Oxford 1903.

Mahler, P. Études sur les combustibles solides, liquides et gazeux. ill. Paris 1903.

Meunier, Louis, and Vaney, Clement. La tannerie. Etude, préparation et essai des matières premières, théorie et pratique des différentes méthodes actuelles de tannage, examen des produits fabriqués, publié sous la direction de Léo Vignon. ill. Paris 1903.

Ostwald, W. Scientific foundations of analytical chemistry, treated in an elementary manner. Translated by George M'Gowan. London 1900.

Pairault, E. A. Le rhum et sa fabrication. ill. Paris 1903.

Seubert, Karl. Internationale Atomgewichte von 1903. Leipzig 1903.

Whetham, William Cecil Dampier. A treatise on the theory of solution, including the phenomena of electrolysis. Cambridge 1902.

Wiener, F. Die Weissgerberei, Sämischgerberei und Pergament-Fabrikation. ill. Wien 1904.

Winteler, F. Die Aluminium-Industrie. Braunschweig 1903.

Wohltmann, Dr. F. Chilisalpeter oder Ammoniak? Berlin 1903.

III. *Pamphlets.*

Dyer, Bernard, and Shrivell, F. W. E. The manuring of market garden crops. (*From the Journal of the Royal Horticultural Society*, 27, 1903.)

Fairley, T. On writing and printing inks. (*From the Journal of the Society of Dyers and Colourists, July*, 1903.)

Golding, John. Experiments on peas in water culture. (*From the Centralblatt f. Bakteriologie Abt. II., XI.*)

Liversidge, A. The Boogaldi, Barratta Nos. 2 and 3, Gilgoin Nos. 1 and 2, and Eli Elwah or Hay Meteorites, New South Wales. (*From the Journal and Proceedings of the Royal Society of N.S. Wales, Vol.* 36.)

Taylor, R. L. I, On a higher oxide of cobalt. II, A method for the volumetric determination of cobalt. (*From the Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 47, 1902—1903.)

Thwaite, B. H. The effect of flue dust upon the thermal efficiency of hot-blast stoves. (*From the Journal of the Iron and Steel Institute*, 1903, I.)

Vines, S. H. Proteolytic enzymes in plants (II). (*From the Annals of Botany*, XVII, 1903.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 7th.

At the next meeting, on **Thursday**, December 3rd, 1903, at **8** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"On the molecular formulæ of some fused salts as determined by their molecular surface energy." By J. F. Bottomley.

"Acid salts of monobasic acids." By R. C. Farmer.

"The atmospheric corrosion of zinc." By G. T. Moody.

"The solubilities of the hydrates of nickel sulphate." By B. D. Steele and F. M. G. Johnson.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 3rd, 1903.

Abell, Robert Duncombe,

Bradwall, Sandbach, Cheshire.

Assistant Lecturer and Demonstrator in Chemistry in the University College of North Wales, Bangor. Studied in Bangor. "Diploma in Agriculture," 1894; "Diploma in Agricultural Chemistry," 1895; B.Sc. (Wales) with First Class Honours in Chemistry, 1899; Associate of Institute of Chemistry, 1899; 1851 Exhibition Scholar, 1899–1902; Ph.D. (Leipzig) and D.Sc. (Wales), 1902; F.I.C., 1903. "The Condensation of Phenyl ethyl ketone and Benzaldehyde," *Trans.*, 1901, **79**, 928. "The Condensation of Phenyl ethyl ketone with Benzylideneacetophenone and of Acetophenone with Benzylidenepropiophenone," *Trans.*, 1903, **83**, 360. "A Synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane," *Trans.*, **83**, 367.

James J. Dobbie.
H. B. Dixon.
W. H. Perkin, jun.
William A. Bone.
D. L. Chapman.
Kennedy J. P. Orton.
Alexander Lauder.

Appleyard, Percy,

Albany, Western Australia.

Pharmaceutical Chemist. Chemist. Interested in Assay work, and desirous of keeping in touch with Chemical Investigation.

F. W. Richardson.
E. J. Millard.
John C. Hewlett.
T. Donald Watson.
B. E. R. Newlands.
Peter MacEwan.
Thos. Tyrer.

Armstrong, Edward Frankland,

55, Granville Park, Lewisham, S.E.

Salters' Research Fellow, Central Technical College. Ph.D. Berlin. Author of papers in the "Sitzungsberichte der Akademie der Wissenschaft zu Berlin" and the "Berichte der Deutschen Chemischen Gesellschaft," in conjunction with either Prof. van 't Hoff or Prof. E. Fischer.

Henry E. Armstrong.	Percy F. Frankland.
Emil Fischer.	W. Palmer Wynne.
J. H. van 't Hoff.	Gerald T. Moody.

Ashdown, Herbert Henry,

3, Genesta Road, Plumstead.

Analytical Chemist and Metallurgist. Eleven years Assistant in the Laboratory of H. H. Smith, Esq., F.I.C., Royal Laboratory Department, Royal Arsenal, Woolwich. Four years Demonstrator to R. J. Redding, Esq., in Chemistry and Metallurgy at the Royal Arsenal Mechanics Institute. Honours in Chemistry, Metallurgy, and Iron and Steel Manufacture.

R. J. Redding.	F. Mollwo Perkin.
A. Lapworth.	Lionel M. Jones.

Chas. R. Darling.

Attwell, Herbert Moore,

Hill House, Limpley Stoke, Bath.

Student of Royal College of Science (Lond.). Student for three years at above College, and Associate of the Royal College of Science (A.R.C.S.).

James C. Philip.	William A. Tilden.
Chapman Jones.	G. T. Morgan.
M. O. Forster.	M. White Stevens.

Badcock, William Cornish,

The Grammar School, Crediton, Devon.

Science Master in the above school. Studied Chemistry for 3 years at Cambridge, B.A. 1st Class Nat. Sci. Tripos Pt. I. 1900. Desires admission to the Society in order that he may keep in touch with recent work in Chemistry.

M. M. Pattison Muir.	R. S. Morrell.
S. Ruhemann.	E. K. Hanson.

H. J. H. Fenton.

Bailey, Harold James,

40, The Avenue, Pontypridd, South Wales.

Chemist to the Great Western Coll. Co. Coke Works and Bye-product Plant. 4½ years Chemistry Student University College, Sheffield. 2 years Chief Assistant to F. G. Treharne, Esq., F.C.S., Consulting and Analytical Chemist, Cardiff. Chemist at present to Bye-product Recovery Plant at Coke Works (above).

F. Gmlyn Treharne. William H. Oates.
George Young. Henry Annable.
W. Carleton Williams.

Barker, Thomas Vipond,

Exeter College, Oxford.

Undergraduate ; will take Chemistry Schools in June, 1904. Done research work in Chemical Crystallography for nine months under Prof. Groth in Munich ; part of the results already published in the current "Zeit. für. Kryst." s. 275.

Henry A. Miers. H. L. Bowman.
W. W. Fisher. J. E. Marsh.
John Watts.

Beadnell, Charles Marsh,

H.M.S. *Barracouta*, Capetown and West Coast.

Staff Surgeon, Royal Navy. Anxious to obtain the Proceedings of the Society and use of Library.

Chas. E. Beadnell. Thos. Stevenson.
Charles E. Groves. *H. C. H. Carpenter.*
E. A. Tyler.

Bayly, Harold Goodenough,

"Moatside," Bedford.

Analytical Chemist. Associate of the Institute of Chemistry. Student in the Laboratory of Alfred Jörgensen of Copenhagen, Oct—December, 1902. Now Chemist to Messrs. Batey & Co., Mineral Water Manufacturers.

John M. Thomson. D. Northall Laurie.
Herbert Jackson. Alfred H. Allen.
Patrick H. Kirkaldy. Fredk. J. Lloyd,
Gilbert J. Alderton,

Beam, William, M.A., M.D.,
Pension Sima, Cairo, Egypt.

Chief Chemist to the Egyptian Salt & Soda Co. Formerly Chief Chemist to the Baltimore and Ohio Railway in America. Joint Author, with Dr. Henry Leffmann, of the following works: (1) Progressive Exercises in Practical Chemistry; (2) Examination of Water for Sanitary and Technical Purposes; (3) Analysis of Milk and Milk Products; (4) Select Methods in Food Analysis (No. 4 Published by Rebman, London), Blakeston, Philadelphia.

Otto Hehner.
Wm. Chattaway.
H. Droop Richmond.
John Golding.
Arthur R. Ling.
Edward Bevan.

Bliss, Henry James Wheeler,
Balliol College, Oxford.

Student. Studied under Rev. T. C. Porter, Eton College, and 3 years at Balliol College.

T. C. Porter.
R. Tabor Lattey.
D. H. Nagel.
H. B. Hartley.
Henry E. Roscoe.
William Crookes.

Bluman, Nicholas John,
10, Amersham Road, New Cross, S.E.

Works Chemist. Day student for 3 years under Dr. F. Mollwo Perkin in the Borough Polytechnic Laboratories, and assistant in Practical Chemistry Classes during the session 1902–3.

F. Mollwo Perkin.
Edwin C. Jee.
Bertram Blount.
John E. Mackenzie.
J. T. Hewitt.
O. J. Steinhart.

Brühl, Paul,
Engineering College, Sibpur, near Calcutta.

Professor of Physics, Mineralogy, and Geology, Engineering College, Sibpur. Lecturer on Chemistry, Rajshahye College, 1882–1887. Professor of Physics and Chemistry, Engineering College, Sibpur, 1887-1895. Professor of Physics, Geology and Mineralogy, 1896 to the present time.

William Tate.
David Hooper.
Prafulla Chandra Ray.
Walter T. Grice.
H. E. Stapleton.

Buggé, Erasmus Robert,

327, Grove Green Road, Leytonstone.

Chemist. Student in Chemistry 1895 and 1896 under Dr. Hewitt. Holder of various certificates from the Science and Art Dept., S.K. Engaged at the Chemical Works of Messrs. Walter Voss & Co., Millwall, for 9 years, and has there done a considerable amount of analytical and research work, and is now desirous of being privileged to attend the meetings of the Society and to enjoy the benefit of the Society's Literature and Library.

Alfred C. Young.	Isaac S. Scarf.
Walter A. Voss.	J. T. Hewitt.

Charles E. Sohn.

Clacker, William,

Bryantwood, Auckland Road, Ilford.

Analytical Chemist. From 1892 to present time. Chemist with Henry Tate and Sons, Ltd., Silvertown, Sugar Refiners. Studied Chemistry under Dr. Hewitt at the East London Technical College, and obtained 1st Class at the London Matriculation.

J. Woodward.	Hugh Main.
J. T. Hewitt.	D. Bendix.
Albert Harrison.	*B. E. R. Newlands.*

Deeks, William Thomas,

High St., Shanklin, I. of W.

Pharmaceutical Chemist. Interested in the Bacteriology of Fermentation.

Frank Oram.	J. Brierley.
Harry Wilson.	*Robert Wright.*

Walter S. Crocker.

Derwent, Ernest,

36, Sixth and Railroad, Ironton, Ohio, U.S.A.

Analytical Chemist. 12 years' experience in Analysis of Iron and Steel, Refractory Material, etc. Chief Chemist to Union Iron and Steel Co., Ironton, Ohio, U.S.A.

J. E. Stead.	*C. H. Ridsdale.*
H. Frankland.	*John Pattinson.*
E. H. Saniter.	*J. T. Dunn.*

Ellis, Henry Russel,

177, Warwick Road, W.

Science Teacher. Inter. B.Sc. London [Working for Honours

Chemistry at Final B.Sc.]. Teacher of Chemistry at Regent Street Polytechnic. Wishes to become a Member to obtain the advantages of the meetings and the Journal, and to keep in touch with modern chemical advances.

Frank E. Weston. J. Bernard Coleman.
J. C. Crocker. *O. Loewenthal.*
R. W. Sindall.

Fawsitt, Charles Edward,
9, Foremount Ter., Glasgow, W.

Demonstrator in Chemistry, University of Edinburgh. Am engaged in original research in physical chemistry. Published work in *Zeitschrift für Physikal. Chemie*, 1902. Member of the Society of Chemical Industry, the Faraday Society, the German Chemical Society, ex-1851 Exhibition Scholar, Ph.D., B.Sc., author of "Tables for Students of Quantitative Chemical Analysis" (Clay, 1903).

Alex. Crum Brown. Leonard Dobbin.
James J. Dobbie. Morris W. Travers.
James Walker. Alexander Lauder.

Forster, William,
6, North Railway Street, Seaham Harbour.

Pharmaceutical Chemist. Formerly a student under Mr. Wm. Fowler, F.C.S., Sunderland, and Mr. Wm. Duncan, F.C.S., Royal Dispensary, Edinburgh; and at the Pharmaceutical Society's School, Bloomsbury Square.

William Fowler. J. Norman Collie.
William Duncan. Arthur Lapworth.
T. E. Wallis.

Friend, John Albert Newton,
2, Francis Road, Watford, Herts.

Science Master at Watford Grammar School. B.Sc. (Honours Chemistry) Birmingham University, 1902. M.Sc. (for Research on the Reaction between Caro's acid and H_2O_2) Birmingham University, 1903. Priestley Research Scholar at Birmingham University (from 1902—3). Late Assistant Demonstrator at University, Birmingham (1901—2).

Percy F. Frankland. Alex. Findlay.
Alex. McKenzie. T. Slater Price.
Thomas Turner.

Gardiner, Ernest Alexander,

Bretherton, Nr. Preston Lancs.

Teacher. B.A. Keble College, Oxford. 1st Class in Final Honour School of Chemistry (June 1903). Senior Science Master at the Plymouth and Mannamead College. Engaged in Research Work on Inorganic Chemistry.

W. W. Fisher. J. E. Marsh.
John Watts. Allan F. Walden.
H. L. Bowman.

Gatehouse, Frank Brooks,

56, Windmill Street, Gravesend, Kent.

Demonstrator in Chemistry and Metallurgy. Assistant analytical chemist. Two years in laboratory under J. W. Gatehouse, F.I.C., Public Analyst for Bath, &c. Four and a half years as student-demonstrator at the Merchant Venturers' Technical Coll. Bristol, under Prof. J. Wertheimer, B.Sc., F.I.C., F.C.S.; Associate of the Merchant Venturers' Technical Coll., Bristol, and Assistant Chemist to the "Associated Portland Cement Manufacturers, Ltd., Gravesend and London." Author of "Process for estimation of Cyanide in the presence of a Chloride" (*Chem. News*, Oct. 25, 1901). Has passed Honours Part II. inorganic and organic Chemistry, and Hons. Pt. I. Metallurgy, Brd. of Ed. practical examinations.

J. Wertheimer. Arnold Philip.
G. P. Darnell Smith. *F. Wallis Stoddart.*
A. E. Thomas. *Ernest H. Cook.*

Gent, Percy William,

792½, Ridge Street, Newark, N. J., U.S.A.

Metallurgical Chemist. Student for three years at University College, London, under Sir William Ramsay, K.C.B., F.R.S.; also at Royal College of Science, S. Kensington. Assistant Chemist with Dr. Paul Jeserich, Gerichts-Chemicker of Charlottenburg, Berlin, and afterwards with Messrs. Morris & Co., Metal Extractors, Doncaster. Now metallurgical chemist with the Balbach Smelting and Refining Co., Newark, N. J., U.S.A.

William Ramsay. Otto Hehner.
Edward C. Cyril Baly. Allan T. Hall.
Thomas Gough. Morris W. Travers.

Grundy, Frank Barnes,

Red Lodge, King's Road, Richmond, S.W.

Technical Chemist. Three years' Chemical Training, University

College, Victoria University. Assistant to Professor Lewes four years. Eight years Assistant Chemist Welsbach Incandescent Co.; now Manager and Chemist, Ramie Co., Bredbury, Stockport.

Vivian B. Lewes.	James Swinburne.
J. S. S. Brame.	W. R. Cooper.
Charles A. Kohn.	W. Mackean.

Horatio Ballantyne.

Hall, John T.,

West View, Stanwell, Staines.

Manager and Analyst for the Staines Sewage Works, Stanwell. I am a Member of the Sanitary Institute (by Exam.); I am the author of a paper on Sewage Works Management and Analytical Chemistry for Sewage Works Managers, read before a Meeting of the Sewage Works Managers Assoc., July 18th, 1903.

James Ashton.	*W. Watson Will.*
Samuel Rideal.	*A. Wynter Blyth.*
Henry Kenwood.	*A. W. Gerrard.*

Heasman, Harold Montague,

1, Carlisle Road, Finsbury Park, N.

Analytical Chemist. Studied Science at University College under Sir William Ramsay and Prof. Carey-Foster. Studied Metallurgy under C. J. Head, Esq., F.C.S., F.I.C., and at King's College and the Birkbeck Institution. Have been acting as Assistant Chemist for the past four years to Messrs. Stanger and Blount, 2, Broadway, Westminster, where I am still engaged.

S. Dickson.	C. J. Head.
Bertram Blount.	A. M. Kellas.

John E. Mackenzie.

Hendrickson, Arthur V.,

The Gasworks, Lower Sydenham, S.E.

Analytical and Gasworks Chemist. Chemist to the Crystal Palace District Gas Company, Lower Sydenham, for past 2 years.

Robert English.	*Vivian B. Lewes.*
Samuel Rideal.	*W. W. Duffield.*
H. F. Hills.	*F. Napier Sutton.*

Howarth, John George,

"Danes Dyke," Capstone Road, Bournemouth.

Senior Science Master, Bournemouth School. Teacher of Chemistry and Physics (Registered under the Board of Education), for the last eight years, at the Crypt Grammar School, Gloucester, and the Bournemouth School (School of Science).

George Embrey.
W. H. Edwards.
B. S. Gott.
J. M. Collett.
J. S. S. Brame.

Hughes, Edwin Reginald,
106, Queen Victoria St., London, E.C.

Analytical and Metallurgical Chemist. Formerly five years assistant to Mr. Edward Riley. 15 years Chemist to South Wales Steel Works, Llanelly, now practising at above address.

George H. Hughes.
John Hughes.
Bernard Dyer.
B. E. R. Newlands.
E. W. Voelcker.
Thos. Howard.

Hymans, Herbert,
13 and 14, Trinity Sq., E.C.

Manufacturing Chemist (Pharmaceutical and Technical Chemicals and Drugs). Formerly student in the Laboratories of the City of London College under Mr. I. S. Scarf, F.C.S. Pupil Assistant (18 months) in Laboratory of Samuel Rideal, Esq., D.Sc., F.I.C., F.C.S. Assistant (3½ years) in Analytical Laboratory of Messrs. Wright, Layman and Umney, Manufacturing Chemists, London. *Notes*, etc., published:—"New Method for Estimation of Phenols" (Pharmaceutical Journal); "The Occurrence of Sodium Sulphate in Nature" (Pharmaceutical Journal, 1900).

Samuel Rideal.
Ernest J. Parry.
Henry Durham.
Isaac S. Scarf.
J. Wicliffe Peck.

Ibbotson, Edward Charles,
3, Ashgate Road, Sheffield.

Works Manager, Sybry, Searls, & Co., Ltd., Sheffield. Mappin Medallist (Metallurgy). Associate Sheffield University. (4 years) Managing Chemist, The Aruba Island Gold Mining Co., Ltd., Dutch West Indies.

Fredk. J. Merrils.
Lawrence Dufty.
Alfred H. Allen.
G. T. W. Newsholme.
Harry Brearley.

Jackson, William Henry,
73, Church Street, West Hartlepool.

Analytical Chemist. Three years as Articled Pupil and three years as Assistant to Mr. A. C. Wilson, F.R.S.E., District Agricultural

Analyst to the Co. of Durham. Two years as Chemist to the West Yorkshire Iron and Coal Co., Ltd., &c., and during the last four years have been engaged in private practice as Analytical and Consulting Chemist.

A. C. Wilson. Thomas Fairley.
J. Falconer King. George Siddle.
F. W. Richardson.

Jennings, Walter Ernest,
8, Rawdon Terrace, Ashby-de-la-Zouch.

Schoolmaster. Certificated in Honours in Chemistry by the Board of Education. Teacher of Chemistry at Ald. Newton's School, Leicester, for 9 years. Headmaster of the English Department of the Grammar Foundation, Ashby-de-la-Zouch.

W. W. Tunnicliffe. W. Ball.
Fredk. Cowling. *S. I. Crookes.*
C. O'Sullivan.

Kent, Thomas Oliver,
89, Loughboro' Park, Brixton, S.W.

Analytical and Research Chemist. Managing Chemist of the Research Laboratories of Messrs. Oppenheimer, Son, & Co., Ltd. Original work done on the physiological action of the Iron Salts. Am desirous of possessing the literature of the Chemical Society, and keeping in touch with chemical progress.

W. Shepperson. Alan Fletcher.
H. Helbing. A. Searl.
J. T. Ainslie Walker. *C. F. Cross.*
Edward Bevan.

Kielty, John J.,
71, Cairo Road, Walthamstow.

Teacher of Chemistry in the Walthamstow Technical School, Science School A. (1) Teacher of Chemistry for 16 years; (2) 1st Class Honours Practical Chemistry; 1st Class Advanced Theory of Chemistry; 1st Class Advanced Organic Theory; 1st Class Advanced Practical Organic, S.K.; (3) Certificated Teacher and qualified Teacher of Physics and Mathematics.

Jos. S. Bridges. Chapman Jones.
C. A. Buckmaster. James C. Philip.
Isaac S. Scarf.

Knight, Harley Fancutt,

"Ledbury," 64, Amhurst Park, Stamford Hill, N.

Analytical Chemist, Assistant to Bertram Blount, Esq. Certificated student of the Chem. Depart., City of London Guilds Technical College, Finsbury, E.C.

R. Meldola.
F. Southerden.
John Castell-Evans.
Chas. R. Darling.
Bertram Blount.

Laing, John, F.I.C.,

Everlie, Skelmorlie, N.B.

Analytical Chemist. Papers on Destructive and Conservative Distillations of Mineral Oils and their molecular condition. Keith Medal, Royal Scottish Society of Arts, Edinburgh (printed in their transactions). Oil Gas before Society of Chemical Industry (printed in their transactions). Late Chemist and Works Manager, Midlothian Oil Company, Ltd., Straiton, Midlothian. Late General and Commercial Manager, Boson Oil Company, Ltd., near Fréjus, Var. France.

Stevenson Macadam.
George Beilby.
John Hunter.
J. Falconer King.
J. Stanley Muir.

Lamplough, Francis Edward Everard,

Trinity College, Cambridge.

Student. 1st Class Nat. Sci. Tripos, 1902. Major Scholar of Trinity College. Exhibitioner in Chemistry, London Intermediate Science, 1903.

G. D. Liveing.
H. J. H. Fenton.
W. J. Sell.
H. O. Jones.
J. P. Millington.

Lawrence, Henry William,

Wellington, New Zealand.

Analytical Chemist. Chief Assistant, Chemical Laboratory—Agricultural Department, Wellington, N.Z. Formerly assistant to Dr. Voelcker, Royal Agricultural Society's Laboratory, and to Sir Henry Gilbert, Rothamsted Laboratory (10 years). Now with Mr. B. C. Aston, Chemist of Agric. Dept. Wellington, N.Z.

J. Augustus Voelcker.
Harry M. Freear.
Thos. Howard.
E. W. Voelcker.
Bernard Dyer.

Leadbetter, Harold Duff,

95, Capel Road, Forest Gate, London, E.

Assistant Demonstrator at the Royal College of Science, London. Associate of the Royal College of Science, London. Assistant Chemist for 3 years at Messrs. A. Boake, Roberts and Co., Ltd., London, E.

William A. Tilden. G. T. Morgan.
M. O. Forster. H. Burrows.
J. C. Philip.

Le Bas, Gervaise,

Baymont House, St. Aubin's, Jersey.

Science Teacher. B.Sc. London University. Received Chemical Training University College, London. Formerly Science Master, Kingswood School, Bath. At present Science Master, County Intermediate School, Llanelly.

William Ramsay. Edward C. Cyril Baly.
Morris W. Travers. W. Lester Alton.
A. Vincent Elsden.

Macdonald, David Baird,

18, Kimberley Road, Leicester.

Chemist and Laboratory Manager. Studied Chemistry under Dr. David Lees, Glasgow; passed the Pharmaceutical Society's Minor Exam. 1896; gained Kinninmont Gold Medal (Electricity, Magnetism and Botany, 1896); spent 4 years in Pharmaceutical Laboratory, J. F. Macfarlan and Co., Edinburgh, under D. B. Dott, Esq., F.I.C., F.R.S.E., &c.; Studied Essential Oils under W. Watson Will, Esq., Metropolitan Coll. Pharmacy, London; late Chemist to Messrs. Dakin Brothers, Middlesex Street, London, E.C.; now Chemist and Manager to E. H. Butler and Sons, Manufacturing Chemists, New Haymarket, Leicester.

W. Watson Will. Harold E. Burgess.
F. Filmer De Morgan. Peter MacEwan.
Ernest J. Parry. Thos. Tyrer.

McMahon, Frederick William,

61, Brockley Rise, Forest Hill, S.E.

Works Chemist. I received my training as an analytical chemist at St. Thomas's Hospital. First as a student (three years) and then as lecture assistant (four years) under Professor Wyndham R. Dunstan. At present engaged as works chemist to Oxychlorides, Ltd., doing research work.

Wyndham R. Dunstan. Hamilton Wingate.
Arthur W. Crossley. *W. Carrick Anderson.*
H. R. Le Sueur. *James Roberts, Jr.*

Mann, Ernest William,

"Lynton," Willow Avenue, Edgbaston, Birmingham.

Analyst and Chemist to Messrs. Southall Bros. and Barclay, Manuf. Chemists, Birmingham. Apprenticed to the above firm in analytical laboratory for 4 years, assistant chemist 7 years, now chief. Pharmaceutical Chemist. Co-author with the late John Barclay, B.Sc., in a paper on the investigation of Benzoin and allied drugs (*Pharmaceutical Journal,* Mar. 15, 1902). Contributed a paper on the adulterations and methods of detection of Copaiba (*Pharmaceutical Journal*, Mar. 21, 1903).

Alfred Southall.	C. G. Moor.
Frank H. Alcock.	Geo. E. Perry.
Robert H. Pickard.	*A. W. Gerrard.*

Monier-Williams, Gordon Wickham,

The Lammas, Esher, Surrey.

B.A. Oxon. First Class, Honour School of Natural Science, Oxford, 1903. Now a Student in the University of Freiburg.

V. H. Veley.	W. W. Fisher.
H. E. Roscoe.	J. E. Marsh.
Wm. Odling.	*James Dewar.*

William Ramsay.

Nairne, Urban Orlando Scotchburn,

7, Hawthorne Terrace, Ripple Road, Barking, Essex.

Analytical Chemist. Have been for the last five years Assistant to H. Leicester Greville, F.I.C., F.C.S., Chemist to the Commercial Gas Company, and am a First Class Matriculated Student of the London University, and Chemist to the Wandsworth and Putney Gas Co.

H. Leicester Greville.	*W. J. Dibdin.*
D. A. Sutherland.	*Robt. G. Grimwood.*
H. F. Hills.	*W. J. A. Butterfield.*

Nevin, James Victor,

Bristol Dispensary, Bristol.

Pharmacist. I have been engaged in Analytical work for over two years in the Chemical Laboratory, Swindon. Since 1898 have been Pharmacist in charge of the Bristol Dispensary; during that time have had a considerable amount of Analytical work to do.

Ernest H. Cook.	Wm. Berry.
Frederic R. Ellis.	*G. P. Darnell-Smith.*

John C. Umney.

Parry, William,

23, Mount Pleasant, Waterloo, Liverpool.

Schoolmaster. B.Sc. (London University, Mathematics and Chemistry). Teacher of Chemistry in Merchant Taylors' School, Crosby.

W. Ross Innes.	Prosper H. Marsden.
Henry C. Bond.	J. W. Shepherd.

Francis Jones.

Pike, Henry George,

Downton, Salisbury, Wilts.

Demonstrator in Practical Chemistry at the College of Agriculture, Downton. For 20 years Assistant to Dr. Munro. Professor of Chemistry at the College of Agriculture, Downton, Wilts. For 10 years, Demonstrator of Practical Chemistry, Qualitative Analyses, and Quantitative Analyses of Fertilisers, Feeding Stuffs, Waters, Soils, Milk and other Dairy products, &c., at the College of Agriculture.

John M. H. Munro.	John Wrightson.
Alfred J. Wilcox.	*C. H. Corbett.*
F. O. Solomon.	*Bernard Dyer.*

Plymen, George Horace Gladstone,

2, Melton Road, Leicester.

Science teacher in Organised Science School. Government recognised and registered teacher of science (including chemistry) in secondary schools. Six years' experience as student in chemical laboratories; the experience includes work in Honours Stage (South Kensington), and the work laid down in the B.Sc. (Lond.) syllabus. Inter. B.Sc. London University (1900).

William Ball.	*F. W. Toms.*
Edward Masters.	*A. D. Hall.*
W. W. Tunnicliffe.	*E. J. Russell.*
William T. Boone.	*Albert Howard.*
Lewis Ough.	*M. J. R. Dunstan.*

Pollard, William Branch,

68, Finnart Street, Greenock, N.B.

Analytical Chemist B.A. (Cantab.). Second Class Natural Science Tripos, 1901. Technical research on the cause of frothing in boiling sugar solutions.

W. J. Sell.	H. J. H. Fenton.
Sidney Skinner.	William C. T. Beasley.

H. O. Jones.

Redfern, Herbert Stanley, B.Sc.,

U.M.F.C. College, Ningpo, China.

Principal and Lecturer in Science. Took the course prescribed for the Victoria B.Sc. degree in the Honours School of Chemistry at Owens College, Manchester (1899—1900), and Yorkshire College, Leeds (1900—1902). Graduated June, 1902; since which has taken a post-graduate course at Yorkshire College in General and Technical Organic Analysis. Has recently been appointed Principal of the U.M.F.C. College at Ningpo, China, and his duties will include the teaching of Chemistry and Physics. Desirous of having the Society's publications in order to keep himself informed of current investigations.

H. B. Dixon.	Norman Smith.
D. L. Chapman.	Julius B. Cohen.
Wm. A. Bone.	*W. H. Perkin, jun.*

Rich, Stiles William George,

Stanley Street, South Brisbane, Queensland.

Pharmaceutical Chemist. Ten years' experience as Pharmaceutical Chemist, during which time was four years Assistant to A. B. Chater, Esq, F.C.S. (present Public Analyst for Brisbane), and two years as Lecturer at College of Pharmacy, Brisbane.

J. Brownlie Henderson.	Horatio Ballantyne.
Arthur B. Chater.	J. West Knights.

T. H. W. Idris.

Richardson, Harold Ernest,

63, Lansdowne Road, Seven Kings, Ilford.

Science Master at Coopers' Company's School. Bachelor of Arts and Bachelor of Science (London University).

J. T. Hewitt.	W. H. C. Jemmett.
J. McCrae.	A. E. Dunstan.

Harold A. Auden.

Rogers, William David,

36, Grange Road, Smethwick.

Assistant in the Chemical Laboratory, Clifton College, Bristol. Associate of the Royal College of Science for Chemistry. Been engaged in teaching Chemistry for several years under W. A. Shenstone and F. T. S. Houghton, King Edward's School, Five Ways, Birmingham.

W. A. Shenstone.	M. O. Forster.
William A. Tilden.	G. T. Morgan.

G. M. Norman.

Senter, George,

37, Ronalds Road, Highbury, London, N.

Teacher of Chemistry. Sir John Cass Technical Institute, Aldgate, London, E.C. Ph.D. (Leipzig). B.Sc. (Lond.). Pharmaceutical Chemist. Studied Chemistry at Pharm. Society's School; University College, London; Universities of Leipzig and Göttingen; late 1851 Exhibition Research Scholar. *Published Papers*: "Das H_2O_2-Zersetzende Enzym des Blutes" (*Zeit. Phys. Chem.*, 1903, **44**, 257); 1903 "Density of Colloidal Solutions" (with Sir W. Ramsay, K.C.B.), *B. A. Report*, 1901; "Measurement of Temperature" (with Dr. Travers and Dr. Jacquerod), (*Phil. Trans.*, 1902, *A.*, p. 105).

William Ramsay.	Edward C. Cyril Baly.
Charles A. Kohn.	Samuel Smiles.
Morris W. Travers.	*J. Norman Collie.*

Slator, Arthur,

The Priory, Burton-on-Trent.

Demonstrator and Lecturer at University College, Nottingham, having the following degrees: Ph.D. (Leipzig), M.Sc. (Birmingham), B.Sc. (London), and having contributed a paper on "The Chemical Dynamics of the Reactions between Chlorine and Benzene" to the *J. Chem. Soc.*, 1903, **83**, 729.

F. Stanley Kipping.	T Slater Price.
Percy F. Frankland	R. M. Caven.

Henry J. S. Sand.

Smith, Frank Gurney,

7, Luxemburg Gardens, Brook Green, W.

Chemical Student. Diploma of Associate of City and Guilds Institute (1902). Since October, 1902, have been engaged in Research work under the direction of Dr. Armstrong at the Central Technical College.

Henry E. Armstrong.	William A. Davis.
Gerald T. Moody.	William Robertson.
T. Martin Lowry.	Edward W. Lewis.

Smith, William Veysey,

7, Grove Road, Ipswich Road, Norwich.

One of His Majesty's Inspectors of Factories under the Home Office. Formerly Postmaster in Natural Science (Chemistry) at Merton College, Oxford. Second-Class Final Honour School of Chemistry, Oxford. B.A. I have held a Science Mastership at Cranbrook School, Kent, and Blundell's School, Tiverton.

W. W. Fisher.	V. H. Veley.
John Watts.	*Allan F. Walden.*
J, E. Marsh.	*H. L. Bowman.*

Stewart, Alfred Walter,

18, Annfield Terrace, Partick Hill, Glasgow.

Student. Bachelor of Science, Glasgow University, 1902; was appointed Research Student in Chemistry, 1901; spent a winter semester in Germany on Research work, 1902–3; was appointed to an 1851 Exhibition Scholarship (1903).

John Ferguson.	James Roberts, jun.
W. Carrick Anderson.	Matthew A. Parker.

D. R. Boyd.

Tighe, Arthur,

20, Marlborough Place, St. John's Wood.

Chemical Student. Student under Basil Turner, Esq., Assayer of Sydney, N.S.Wales (eighteen months). Lecturer, Sydney University. Student under A. C. Chapman, Esq., F.I.C., of Duke St., Aldgate, E.C. (twelve months). Also at Finsbury College for one course.

Alfred C. Chapman.	F. Southerden.
R. Meldola.	F. Guy Stirling Baker.

Fredk. J. Harry.

Turner, Arnold,

316, Entwisle Rd., Rochdale.

Brewer and Chemist. A Student in the Brewing Section of Chemical Department, Manchester School of Technology for three years. Obtained first place in Honours and the Silver Medal in Brewing, of City and Guilds, London, 1903. Desirous of obtaining the Society's Journal for purposes of study.

William J. Pope.	S. J. Peachey.
Jas. Grant.	L. G. Radcliffe.

F. S. Sinnatt.

Turner, William Ernest Stephen,

52, Cheshire Road, Smethwick.

Science Teacher. Science Instructor to the Oldbury Higher Education Committee. Birmingham University Research Scholar. B.Sc. (London).

Percy F. Frankland.	Alex. Findlay.
Alex. McKenzie.	T. Slater Price.

R. Lloyd Whiteley.

Walker-Pole, Miles,

71, De Korle Street, Braamfontein, Johannesburg.

Analytical and General Chemist. Registered as a Chemist and Druggist under the Pharmaceutical Society of Great Britain, October 7, 1893. Granted Diploma by the "Raad van Examinatoren," Pretoria, March 17, 1896, for special mining analytical report. Chemical work under Stevenson Macadam, Edin., 1891. Eight years' practical experience Gold Assay and General Mining Chemistry. Assay work under Dr. Muter, Kennington, 1894. Experiments in Amalgamation, resulting in the production of a metal for mining pumps which stands the action of the Rand water better than that in use before.

John Muter. John C. Hewlett.
E. J. Millard. *Peter MacEwan.*
R. L. Jenks.

Weiss, Carl Friederich Richard,

37, Binfield Road, Clapham, London, S.W.

Formerly Analytical Chemist (Assistant of Prof. Dr. Migula, Karlsruhe, Bad.), now Pharmaceutical Chemist. Studied Chemistry at Berlin University, 2 years; Bacteriology at Karlsruhe Polytechnic, 1 year; Bacteriology and Chemistry at Bâle University, 1 year. Ph.D., M.A., Bâle University. Diploma as German Apotheker, Berlin University; M.Ph.S., London. Author of "Ueber die Bacterienflora der sauren Gährung einiger Nahrungs und Genussmittel," 1899.

Otto Hehner. H. Helbing.
Oscar Guttmann. *Arthur R. Ling.*
B. E. R. Newlands.

Wright, Fred,

Terry Street, Balmain, N.S.W.

Chemist. Lecturer in Pharmacy, Materia Medica, and Pharmaceutical Chemistry, Technical College, Sydney, 1882—1902. Pharmaceutical Chemist to Elliott Bros. (Limited), Manufacturing Chemists, Balmain, Sydney, N.S.W.

Henry G. Smith. Will. A. Dixon.
William M. Hamlet. *W. M. Doherty.*
Andrew J. Dixon.

The following were recommended by the Council for presentation to ballot under Bye-Law I. (3):

Kin, Thein,
Rangoon.

Assistant to the Chemical Examiner, Burma. Studied Chemistry in the Rangoon College. B.A., Calcutta University, 1895. First Assistant to the Lecturer in Chemistry and Physical Science, Rangoon College, 1896—1901. Assistant to the Chemical Examiner, Burma, from April, 1901.

M. Hunter. *Andrew Campbell.*

Prasad, Mata,
Beni lal's Katra, Benares City.

Merchant and Honorary Lecturer in Chemistry. M.A. First Class Allahabad University, late Professor Physical Science Barelly College, at present Honorary Professor and Lecturer of Chemistry Central Hindu College, Benares.

Arthur Richardson. *Sydney Young.*
Abhayacharan Sanyal. *Francis G. Francis.*

Robertson, Philip Wilfred,
20, Talavera Terrace, Wellington, New Zealand.

Student. Author of "Atomic and Molecular Heats of Fusion," T., 1233, P., 1902, 131. Sir George Grey Scholar in Physics and Chemistry at Victoria College. At present engaged in research in Organic and Physical Chemistry under Professor Easterfield.

Thomas H. Easterfield. J. S. Maclaurin.

R. CLAY AND SONS LTD., BREAD ST. HILL, E.C., AND BUNGAY SUFFOLK.

Issued 11/12/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 272.

Thursday, December 3rd, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. M. Kemp-Welch and J. T. Ainslie Walker were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Alfred Denys Cowper, 3, Bishop's Mansions, Fulham, S.W.
Nevil Norton Evans, McGill University, Montreal, Canada.
John Monteath Guthrie, 199, Ferry Road, Leith, N.B.

The President announced that since the last meeting a photograph of the portrait of Roger Bacon which is in Knole House, had been presented to the Society by Mr. Oscar Guttmann.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Robert Duncombe Abell, Ph.D., D.Sc.
Percy Appleyard.
Edward F. Armstrong, Ph.D.
Herbert Henry Ashdown.
Herbert Moore Attwell.
William Cornish Badcock, B.A.
Harold James Bailey.
Thomas Vipond Barker.
Harold Goodenough Bayly.
Charles Marsh Beadnell.
William Beam, M.A., M.D.
Henry James Wheeler Bliss.
Nicholas John Bluman.
Paul Brühl.

Erasmus Robert Buggé.
William Clacher.
William Thomas Deeks.
Ernest Derwent.
Henry Russel Ellis.
Charles E. Fawsitt, Ph.D., B.Sc.
William Forster.
John Albert N. Friend, M.Sc.
Ernest A. Gardiner, B.A.
Frank Brooks Gatehouse.
Percy William Gent.
Frank Barnes Grundy.
John T. Hall.
Harold Montague Heasman.
Arthur V. Hendrickson.
John George Howarth.
Edwin Reginald Hughes.
Herbert Hymans.
Edward Charles Ibbotson.
William Henry Jackson.
Walter Ernest Jennings.
Thomas Oliver Kent.
John J. Kielty.
Thein Kin, B.A.
Harley Fancutt Knight.
John Laing.
Francis E. E. Lamplough, B.A.
Henry William Lawrence.
Harold Duff Leadbetter.
Gervaise Le Bas, B.Sc.
David Baird Macdonald.
Frederick William McMahon.
Ernest William Mann.
Gordon W. Monier-Williams, B.A.
Urban Orlando S. Nairne.
James Victor Nevin.
William Parry, B.Sc.
Henry George Pike.
George Horace G. Plymen.
William Branch Pollard, B.A.
Mata Prasad, M.A.
Herbert Stanley Redfern, B.Sc.
Stiles William George Rich.
Harold E. Richardson, B.A., B.Sc.
Philip Wilfred Robertson.
William David Rogers.
George Senter, Ph.D., B.Sc.
Arthur Slator, Ph.D., M.Sc.
Frank Gurney Smith.
William Veysey Smith, B.A.
Alfred Walter Stewart, B.Sc.
Arthur Tighe.
Arnold Turner.
William Ernest S. Turner, B.Sc.
Miles Walker-Pole.
Carl Friederich R. Weiss, Ph.D.
Fred Wright.

*158. "The molecular formulæ of some fused salts as determined by their molecular surface energy." By J. F. Bottomley.

The electrolytic conductivity of fused salts has not been satisfactorily explained, but it might be expected that ionisation would be produced by the presence of complex molecules, and, at Sir William Ramsay's suggestion, measurements of the variation of the capillary rise with temperature were undertaken with the object of testing this point. The determinations with lithium and silver nitrates, potassium chlorate and dichromate, zinc and stannous chlorides were unsatisfactory owing to experimental difficulties, and successful results were obtained only with sodium and potassium nitrates. The average value of K for sodium nitrate is 0·503, and for potassium nitrate, 0·445, instead of 2·12, the normal value for non-associating substances. This implies that 9 or 10 molecules of the simple salt, $NaNO_3$ or KNO_3, are associated to form a complex, the supposition that a portion of the salt is ionised by the complex molecules of another portion being therefore rendered probable.

*159. "The atmospheric corrosion of zinc." By G. T. Moody.

The recorded observation that hydrogen peroxide may be detected during the oxidation of zinc in presence of water has been brought forward by Dunstan in support of his contention that, in the case of iron, hydrogen peroxide "is a necessary intermediate product of the chemical change involved in rusting" (Report of the Steel Rails Committee of the Board of Trade, 1900; this vol., p. 152). It consequently appeared of interest to determine if the scale formed during the atmospheric corrosion of zinc showed a composition which would justify the assumption that it is to be regarded as an oxidation product formed by the interaction of metal, water, and oxygen. To this end, strips of thin sheet zinc were suspended in a muslin bag under the shelter of a north wall and exposed to the full effects of the atmosphere for 5 months. At the end of this period, the semi-crystalline scale was detached from the metal and dried; it had a composition closely agreeing with the formula $ZnCO_3,3Zn(OH)_2$. The production of this basic carbonate may be regarded as evidence that the atmospheric corrosion of zinc is to be attributed not to direct oxidation of metal, but to an interaction with carbonic acid. This view is supported by the behaviour of zinc in a saturated solution of carbon dioxide. The metal dissolves with evolution of hydrogen and formation of zinc hydrogen carbonate. The resulting solution, when heated or exposed to air, becomes turbid and on spontaneous evaporation yields a basic carbonate agreeing in composition with the product of atmospheric corrosion.

Whilst zinc is rapidly converted into hydroxide by commercial hydrogen peroxide, this metal like iron remains practically unattacked when in contact with pure 30 per cent. peroxide. The statement made by Dunstan (*loc. cit.*) that iron, zinc, and lead behave similarly towards hydrogen peroxide is not in agreement with the observations of the author, who finds that the addition of a few milligrams of assay lead induces immediate decomposition of 30 per cent. peroxide, oxygen and steam escaping with almost explosive violence. The lead becomes superficially coated with brown peroxide and presents an appearance quite different to that arising from atmospheric corrosion.

The author concludes that the atmospheric corrosion of zinc, like that of iron, is the result of interaction between metal and acid, and that the attack on zinc is less marked because the acid is in a great measure retained in combination as basic carbonate.

*160. "The formation of urea by the direct hydrolysis of lead cyanate." By A. C. Cumming.

Lead cyanate is readily and quantitatively transformed into lead carbonate and urea by direct hydrolysis with boiling water: $Pb(CNO)_2 + 2H_2O = PbCO_3 + CON_2H_4$. This salt, which is prepared by adding lead nitrate to potassium cyanate solution from which the carbonate has previously been removed by barium nitrate, is fairly stable at the ordinary temperature and may be washed with cold water until free from impurities.

The progress of the change was followed qualitatively with a polarising microscope, advantage being taken of the fact that the small acicular crystals of lead cyanate which polarise light are gradually replaced by amorphous granules of lead carbonate.

The action was also followed quantitatively by a titration method which depends on the fact that lead cyanate neutralises twice as much acid as the products of its hydrolysis.

No evidence was obtained of the formation of ammonium cyanate, and this method is therefore distinct from any earlier synthesis.

Discussion.

The President expressed surprise that this reaction had not already been observed, remembering the use of lead cyanate in a process introduced many years ago by the late Mr. John Williams for the manufacture of urea (*J. Chem. Soc.*, 1868, 21, 63).

161. "Acid salts of monobasic acids." By R. C. Farmer.

The substituted benzoic acids have the general property of forming salts containing one molecule of the free acid to one molecule of neutral salt. The potassium and ammonium salts were taken as typical, and the acid salts of benzoic acid and its methyl, hydroxy-, bromo-, and nitro-derivatives were examined. These substances form well-defined, crystalline compounds, which do not undergo any change at the melting points of the free acids; they are not affected by inert solvents, but are at once decomposed by water. Experiments on the ratio of distribution of the acids between benzene and aqueous solutions of their normal salts showed that these acid salts do not exist to any appreciable extent in aqueous solution. In alcohol, on the other hand, the dissociation is only partial, as was shown by molecular weight determinations at the boiling point.

162. "The solubility curves of the hydrates of nickel sulphate." By B. D. Steele and F. M. G. Johnson.

The solubilities of the hydrates of nickel sulphate have been determined at temperatures ranging from − 5° to 99°, and equilibrium curves have been constructed for the following hydrates : $NiSO_4,7H_2O$, $NiSO_4,6H_2O$ (blue quadratic), and $NiSO_4,6H_2O$ (green monoclinic). A fourth hydrate is deposited from saturated solutions at temperatures above 118°, and the salt separating at 131° has been analysed and found to be the dihydrate, $NiSO_4,2H_2O$.

The following quadruple points have been fixed : (1) the cryohydrate point of the heptahydrate (− 4·15°). (2) The transition point (31·5°) : $NiSO_4,7H_2O \rightleftarrows NiSO_4,6H_2O$ (blue) + saturated solution. (3) The transition point (53·3°) : $NiSO_4,6H_2O$ (blue quadratic) $\rightleftarrows NiSO_4,6H_2O$ (green monoclinic). The transition point of the change : $NiSO_4,6H_2O \rightleftarrows NiSO_4,2H_2O$ + saturated solution, has not been determined.

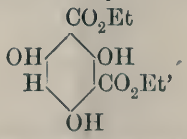
163. "Action of malt diastase on potato starch paste." By B. F. Davis and A. R. Ling.

In continuing their earlier experiments (*J. Fed. Inst. Brewing*, 1902, 8, 475), the authors show that a solution of diastase, when heated above 55°, becomes weaker in its action and that the alteration produced in the enzyme molecule is a permanent one, for the diastase retains its acquired properties when it is reprecipitated from its solution by alcohol and allowed to act on starch paste at or below 55°. The altered diastase produces *d*-glucose when it acts on starch paste, and the change appears to commence when a solution of the enzyme is heated below 60°, although, judging from the small amount of *d*-glucose produced, the reaction is not complete at this temperature. As the temperature of the initial heating is raised, the amount of *d*-glucose produced by the enzyme also increases, the maximum amount being obtained by the action of diastase, which has been previously heated in solution at 68—70° for fifteen to thirty minutes. Above this temperature, the destruction of the enzyme is so rapid that a much larger proportion has to be employed to attain that stage of the reaction at which *d*-glucose appears. Nevertheless, *d*-glucose is formed by diastase which has been heated to 78°, and probably at even higher temperatures. It has been observed in all cases that when the solution is kept at the temperature of hydrolysis (usually 55°) after the maximum amount of *d*-glucose has been formed, the amount of this sugar present diminishes, and the occurrence of this apparent condensing action of the enzyme may probably in several cases explain the failure to detect *d*-glucose among the products of hydrolysis. The maximum amount of *d*-glucose formed in any case does not exceed about 12 per cent. of the total hydrolytic products.

164. "The formation of phloroglucinol by the interaction of ethyl malonate with its sodium derivative." By C. W. Moore.

In the year 1885, Baeyer made the important discovery that when ethyl malonate is heated with its sodium derivative at 145°, a derivative of phloroglucinol is formed, which melts at 104°, and which Baeyer considered was ethyl phloroglucinoltricarboxylate, $C_6(OH)_3(CO_2Et)_3$ (*Ber.*, 1885, **18**, 3457).

During the course of an investigation involving the use of ethyl malonate, the author was led to reinvestigate this matter, and he has been able to prove that the substance formed under the conditions employed by Baeyer is ethyl phloroglucinoldicarboxylate, $C_6H(OH)_3(CO_2Et)_2$, and not the above-mentioned tricarboxylate. The molecular weight determination in benzene solution gave 273 and 270, whereas the molecular weights of the dicarboxylic and tricarboxylic esters are 270 and 342 respectively. The determination of the ethoxyl groups, which was carried out by Dr. W. H. Perkin, sen., also gave numbers which clearly show that the substance is a dicarboxylic ester. When treated with bromine, it yields a bromide having the composition $C_6Br(OH)_3(CO_2Et)_2$, which was first prepared by Bally (*Ber.*, 1888, **21**, 1770). Since it also yields a triacetyl compound when heated with acetic anhydride, there can scarcely be a doubt that Baeyer's ester must be represented by the formula



and that it is therefore *ethyl phloroglucinoldicarboxylate.*

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bloxam, Charles Loudon. Chemistry, inorganic and organic. With experiments. 9th edition. By John Millar Thomson and Arthur G. Bloxam. pp. xii + 872. ill. London 1903. From the Publishers.

Bolton, Henry Carrington. Contributions of alchemy to numismatics. pp. 44. ill. New York 1890. From the Author.

Browning, Philip E. Introduction to the rarer elements. pp. viii + 158. New York 1903. From the Publishers.

Clough, W. T., and Dunstan, A. E. Elementary experimental science. pp. 239. ill. London 1904. From the Authors.

Clowes, Frank, and Coleman, J. Bernard. Elementary practical chemistry. Part I. General chemistry. 4th edition. pp. xvi + 198. ill. London 1903. From the Publishers.

Duhem, P. Thermodynamics and chemistry. A non-mathematical treatise for chemists and students of chemistry. Authorized translation by G. K. Burgess. pp. xxii + 445. ill. New York 1903. From the Publishers.

Elbs, Karl. Electrolytic preparations. Exercises for use in the laboratory by chemists and electro-chemists. Translated by R. S. Hutton. pp. 100. ill. London 1903. From the Translator.

Ellis, C. Sordes. Elementary chemistry of photographic chemicals. pp. 120. ill. London 1903. From the Author.

Henry, T. A. Aids to chemistry. pp. 316. London 1903. From the Author.

Hoff, J. H. van't. Physical chemistry in the service of the sciences. English version by A. Smith. pp. xviii + 126. ill. Chicago 1903. From the Publishers.

Landolt, Hans. Assisted by Schönrock, O., Lindner, P., Schütt, F., Berndt, L., and Posner, T. The optical rotating power of organic substances, and its practical applications. Authorized translation with additions by J. H. Long. pp. xxii + 752. ill. Easton, Pa. 1902. From the Publishers.

Lassar-Cohn. The praxis of urinary analysis. A guide to the chemical analysis of urine. With directions for preparing artificial pathological urines for practicing the various tests, and an appendix on the analysis of stomach contents. Authorized translation by H. W. F. Lorenz. pp. vi + 58. New York 1903. From the Publishers.

Mathias, E. Le point critique des corps purs. pp. viii + 255. ill. Paris 1904. From the Author.

Sorel, Emile. La grande industrie chimique minérale. pp. 679. ill. Paris 1904. From the Author.

Wright, Charles Romley Alder. Animal and vegetable fixed oils, fats, butters, and waxes: their preparation and properties, and the manufacture therefrom of candles, soaps, and other products. 2nd edition, edited and partly rewritten by C. Ainsworth Mitchell. pp. xvi + 804. ill. London 1903. From the Publishers.

II. *By Purchase.*

Hausbrand, E. Die Wirkungsweise der Rektifizier-und Destillier-Apparate mit Hilfe einfacher mathematischer Betrachtungen. 2 Aufl. pp. 114. ill. Berlin 1903.

Heermann, Paul. Koloristische und textilchemische Untersuchungen. pp. 398. ill. Berlin 1903.

Hoyer, Egbert, und Kreuter, Franz. Technologisches Wörterbuch. Band I. Deutsch-Englisch-Französisch. Band II. Englisch-Deutsch-Französisch. Band III. Französisch-Deutsch-Englisch. 5 Aufl. pp. 884, 877, 790. Wiesbaden 1902—1904.

At the next ordinary meeting, on **Wednesday**, December 16th, 1903, at **5.30** p.m., the following papers will be communicated:—

"The relative strengths of the fixed bases and ammonia as measured by their action on cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

"New halogen derivatives of diphenyl and dihydroxydiphenyl." By J. C. Cain.

"Constitution of nitric peroxide." By E. Divers.

"Sabatier's nitrosodisulphonic acid." By E. Divers.

"Notes on some natural colouring matters." By A. G. Perkin and E. Phipps.

"The estimation of methyl alcohol in presence of ethyl alcohol." By T. E. Thorpe and J. Holmes.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 273.

Wednesday, December 16th, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. E. F. Armstrong, H. J. W. Bliss, E. R. Hughes, B. Ingram, and C. Müller were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Alick Cole Benson, 33, Perham Road, West Kensington.
Robert Gawler, M.Sc., 3, South View Terrace, Leeds.
Leo Frank Guttmann, Ph.D., 18, Aberdare Gardens, N.W.
Cyril Douglas McCourt, 52, Victoria Road, Clapham, S.W,
Benjamin L. Murray, 19, University Place, New York.
Thomas Stewart Patterson, Ph.D., Lyddon Hall, Leeds.
Alfred Shrubsole, 91, Holyhead Road, Coventry.
Samuel John Smith, 41, Grafton Street, Dublin.
Alfred Tingle, Ph.D., B.Sc., Shantung, China.

Of the following papers, those marked * were read :

***165. "The relative strengths of the alkaline hydroxides and of ammonia as measured by their action on cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.**

The authors have shown (Trans., 1903, **83**, 598) that in aqueous solution, cotarnine has the "ammonium hydroxide" form, whereas in ethereal or chloroform solution it exists as a "carbinol."

These two forms are distinguished by having widely different and very characteristic absorption spectra (*loc. cit.*, Plate I, carbinol form; Plate II, ammonium hydroxide form).

When cotarnine in aqueous solution is acted on by sodium hydroxide or any other soluble base, it is converted into the carbinol form. The proportion of the cotarnine which undergoes this change depends on the amount of sodium hydroxide present, the change being practically complete when a milligram-molecule of cotarnine is dissolved in one litre of normal sodium hydroxide solution. After the addition of any given quantity of sodium hydroxide, a state of equilibrium is established almost instantaneously, and no further change takes place in moderately dilute solutions, even after several hours, provided that the temperature is kept constant. Each additional quantity of sodium hydroxide causes a further transformation of "ammonium hydroxide" into "carbinol" form. This change can be followed through all its phases by photographing the spectra of the solution after each addition of sodium hydroxide, the spectra obtained being in reality those of mixtures of the two modifications (*loc. cit.*, Plate III, Figs. 17—24), the relative amounts of which can be determined by comparing these photographs with a standard series obtained by photographing the spectra of solutions prepared by mixing the two forms of cotarnine in definite proportions. It is possible, therefore, to estimate the amount of change which any given quantity of sodium hydroxide produces in an aqueous solution of cotarnine, and to obtain a curve representing the effect of successive additions of the alkali.

The action of ammonia and of the hydroxides of lithium, sodium, potassium, barium, and calcium has been examined in this way. The curves for the first three hydroxides are nearly identical, from which it is inferred that, so far as their action on cotarnine is concerned, they have practically the same strength; those of the last two agree with one another but differ slightly from the others, indicating a slight inferiority of strength, especially for the more concentrated solutions.

The curve for ammonia, which differs widely from those of the alkaline hydroxides, indicates that this base is much weaker than the latter substances.

DISCUSSION.

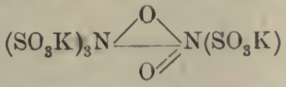
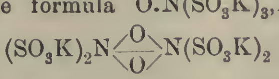
Mr. W. C. REYNOLDS expressed the hope that Prof. Dobbie would be able to investigate, in this connection, the parent bases, hydrastine and narcotine, from which hydrastinine and cotarnine are derived by oxidation. In the case of hydrastine, he had noticed the existence of two modifications, one variety melting at about 131—132° and the other at a temperature somewhat above 140°. If either variety was dissolved in alcohol or acetone and the solvent removed at the temperature of the water-bath, the less fusible variety was obtained; but if the solution was allowed to evaporate spontaneously, or if a concentrated hot solution was cooled and then allowed to crystallise, the more fusible variety was obtained. The less fusible variety was always produced by the fractional precipitation by ammonia of the hydrastine salts.

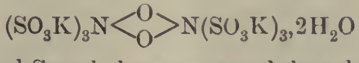
Moreover, if the temperature when in the neighbourhood of the melting point was raised very slowly (about 1° per half hour), the crystals appeared to change from the more fusible to the less fusible modification. The crystals which melted at 131—132°, when heated in the ordinary manner, did not soften until the temperature was considerably above 140°, and then melted somewhat indefinitely.

Under similar conditions, both varieties seemed to have the same specific rotation in solution.

Similar changes were not observed in the case of the allied alkaloid, narcotine.

*166. "Peroxylaminesulphonates and hydroxylaminetrisulphonates (sulphazilates and metasulphazilates)." By T. Haga.

By oxidising potassium hydroxylaminedisulphonate, Fremy obtained the salts which he called sulphazilate and metasulphazilate. Claus re-named the former "oxysulphazotate," and formulated its constitution as  $(SO_3K)_3N\overset{O}{\underset{O}{-\!\!-\!\!-}}N(SO_3K)$; the latter he called "trioxyazoate," giving it the formula $O\colon N(SO_3K)_3,H_2O$. Raschig changed these formulæ into  $(SO_3K)_2N{<}^{O}_{O}{>}N(SO_3K)_2$ and



$$(SO_3K)_3N{<}^{O}_{O}{>}N(SO_3K)_3,2H_2O$$

whilst Hantzsch and Semple have re-named the sulphazilate "nitroxydisulphonate" with the formula, $O\cdot N\colon(SO_3K)_2$, and have gone back to Claus's formula for the metasulphazilate.

The author has found that (1) potassium sulphazilate interacts with normal potassium sulphite, $(SO_3K)_2NO\cdot ON(SO_3K)_2 + K\cdot SO_3K = (SO_3K)_2NOK + (SO_3K)ON(SO_3K)_2$, to form normal potassium hydroxylaminedisulphonate and potassium metasulphazilate; (2) the sulphazilate decomposes spontaneously into the metasulphazilate, hydroxylaminedisulphonate, and much nitrous acid, the last being preserved as nitrite when potassium hydroxide is present: $2(SO_3K)_4N_2O_2 + H_2O = 2(SO_3K)_3NO + (SO_3K)_2NOH + NO_2H$; (3) potassium metasulphazilate is decomposed quantitatively into sulphate and normal aminedisulphonate (iminosulphate) by sodium amalgam or by the zinc-copper couple, $KO{\cdot}SO_2{\cdot}O{\cdot}N(SO_3K)_2 + 2Na = KO{\cdot}SO_2{\cdot}ONa + NaN(SO_3K)_2$; and (4) the ultimate products of its hydrolysis, when heated with hydrochloric acid, are hydroxylamine and sulphuric acid.

The molecular magnitude of sodium hydroxylaminetrisulphonate and also of the 2/3-normal sodium hydroxylaminedisulphonate, as determined by Loewenherz's method, is in each case that which contains only one atom of nitrogen. The constitution of the sulphazilates is therefore that expressed by the name, potassium peroxylaminesulphonate, and the formula, $(SO_3K)_2NO{\cdot}ON(SO_3K)_2$, and of the metasulphazilates that expressed by the name and formula, potassium hydroxylaminetrisulphonate, $(SO_3K)_2N{\cdot}O{\cdot}(SO_3K)$. The sulphazilates are oxime peroxides or peroximes, being produced by oxidising hydroxylaminedisulphonates with a variety of reagents (including ozone), even in the cold ; they behave as oxidising agents, becoming again reduced to hydroxylaminedisulphonates,

$$2(SO_3K)_2NOH \rightleftarrows [(SO_3K)_2NO]_2.$$

A metasulphazilate is the only known case of a triacylated hydroxylamine. Having, as a hydroxylaminetrisulphonate, one of its sulphonate radicles in union with oxygen, it is clearly one-third sulphatic, yet without being actually a sulphate. It is a mixed oxide or anhydride of two acid salts, one being the acid sulphate and the other the 2/3 normal hydroxylaminedisulphonate,

$$(SO_3K)O\boxed{H + HO}N(SO_3K)_2.$$

The inorganic mixed anhydride most closely analogous to a hydroxylaminetrisulphonate is Pelouze's salt, potassium hyponitrososulphate, $(SO_3K){\cdot}O{\cdot}(N_2OK)$, the two salts agreeing in being stable in presence of caustic alkali and in not yielding barium sulphate with a soluble barium salt, whilst giving rise to a sulphate with sodium amalgam or zinc. To understand this behaviour, it is only necessary to assume that the metasulphazilate ionises into three metallic kations and a complex trivalent anion which includes within itself the sulphate radicle. Dunstan and Goulding have shown that zinc and acid reduce trialkylhydroxylamines to trialkylamines, so that if, as has hitherto been supposed, metasulphazilates were oxamines, they should reduce to aminetrisulphonates (nitrilosulphates) and not to aminedisulphonates and sulphates. The author concludes that the nitrogen of the sulphazilates and metasulphazilates is exclusively tri- and not quinquevalent, as suggested by the earlier investigators of these salts.

There is so much difference between the properties of a peroxylaminesulphonate and those of the bluish-violet substance produced by the action of sulphur dioxide on a solution of nitrososulphuric acid in sulphuric acid that it is improbable that Sabatier's suggestion will prove correct as to the latter compound being the acid of Fremy's bluish-violet salt.

Potassium hydroxylaminetrisulphonate is shown to have 3/2 mols. of water of crystallisation, whereas Claus, who stated that the salt contained one mol. of water, was perhaps unaware that some of its water of crystallisation becomes fixed by hydrolysis during the drying. Sodium, ammonium, and hydroxy-lead hydroxylaminetrisulphonates have been prepared for the first time.

*167. "Peroxylaminesulphonic acid." By E. Divers.

In support of Sabatier's assumption that the bluish-violet colour caused by the action of sulphur dioxide on sulphuric acid containing nitrososulphuric acid is due to the formation of the unknown acid of Fremy's bluish-violet potassium salt (sulphazilate or peroxylaminesulphonate), it is pointed out that the difference in properties observed by Haga (preceding note) is hardly greater than that between the behaviour of nitrous acid in the respective forms of nitrososulphuric acid and potassium nitrite.

Sabatier's observations are shown to be quite consistent with the view that the acid is peroxylaminesulphonic acid, that is, a peroxide and a compound of trivalent nitrogen.

*168. "Constitution of nitric peroxide." By E. Divers.

Haga's examination of Fremy's *sulphazilate* has established that it is *peroxylaminesulphonate*, a trivalent nitrogen compound and a peroxide. It is a sulphonated nitric peroxide, as suggested by Hantzsch and Semple, and when decomposed by water, gives a complex anhydrosulphate (hydroxylaminetrisulphonate), on the one hand, and, on the other, nitrous acid and sulphonated nitrous acid (hydroxylaminedisulphonate), equivalent respectively to the nitric and nitrous acids which are yielded by nitric peroxide. Dinitric peroxide is therefore a true peroxide, *nitrosyl peroxide*, $(NO)_2O_2$.

Mononitric peroxide must therefore be regarded as $O{:}N{\cdot}O$, formulated with a univalent oxygen atom, and not with its nitrogen atom in the quadrivalent condition, $O{:}N{:}O$, as suggested by Piloty and Schwerin (*Ber.*, 1901, **34**, 1884 and 2354). For it seems appropriate to consider the constitution of the two forms of nitric peroxide to be the same, the only difference being the presence in the one form of the bivalent double atom of oxygen, and in the other form of a single univalent oxygen atom. A true peroxide is correctly defined as a compound in which some or all of the oxygen is exerting on the rest of the compound only half its usual valency. Piloty and Schwerin's *porphyrexide*, $(C_5H_9N_3)\dot{:}NO$ (*loc. cit.*), is to be regarded as being such a peroxide.

169. "Halogen derivatives of diphenyl and dihydroxydiphenyl." By J. C. Cain.

The author has already shown that only a small amount of 3 : 3′-dichloro-4 : 4′-dihydroxydiphenyl is obtained by boiling the corresponding diazonium salt with water (Trans., 1903, 83, 688), and now describes a method for preparing the substance by chlorinating 4 : 4′-dihydroxydiphenyl.

The following compounds are described: 3 : 3′-*dichlorodiphenyl*, white needles, m. p. 29°, b. p. 298°; 3 : 4 : 3′ : 4′-*tetrachlorodiphenyl*, white needles, m. p. 172°, b. p. 230° under 50 mm. pressure; 4 : 4′-*dibromo*-3 : 3′-*dichlorodiphenyl*, white needles, m. p. 176—177°; 4 : 4′-*diiodo*-3 : 3′-*dichlorodiphenyl*, pale yellow needles, m. p. 162°, b. p. 275° under 10 mm. pressure; 4 : 4′*dicyano*-3 : 3′-*dichlorodiphenyl*, white needles, m. p. 152—153°; 3 : 3′-*dichlorodiphenyl*-4 : 4-*dicarboxylic acid*, white needles, m. p. 287—288°. 3-*Chloro*-4 : 4′-*dihydroxydiphenyl*, white needles, m. p. 215°. 3 : 3′ : 5(?)-*Trichloro*-4 : 4′-*dihydroxydiphenyl*, white needles, m. p. 179°.

170. "Notes on some natural colouring matters." By A. G. Perkin and E. Phipps.

The flowers of the *Prunus spinosa* contain both quercetin and kampherol, whereas in the violet (*viola odorata*) and white clover (*trifolium repens*) quercetin alone has been detected. From the Japanese dyestuff "Fukugi" (botanical origin unknown), a new colouring matter, $C_{17}H_{12}O_6$, has been isolated, forming yellow, prismatic needles (m. p. 288—290°), the general properties of which indicate that it is closely allied to luteolin. On bromination, it yields the compound $C_{17}H_{10}O_6Br_2$ (yellow needles, m. p. 280°), and, when fused with caustic alkali, phloroglucinol and protocatechuic acid are obtained.

Morintetraethyl ether, $C_{15}H_6O_3(OEt)_4$ (yellow, prismatic needles, m. p. 126—128°), closely resembles the corresponding methyl derivative and forms the colourless acetyl compound, $C_{15}H_5O_3(OEt)_4{\cdot}C_2H_3O$ (needles, m. p. 121—123°). When brominated in the presence of alcohol, myricetin yields a mixture of tetrabromomyricetin and *tetrabromomyricetin ethyl ether*, $C_{15}H_5Br_4O_7{\cdot}OEt$ (colourless needles melting completely at 146°).

Cryoscopic determinations of the molecular weight of its acetyl derivative indicate that hesperitin has the formula $C_{16}H_{14}O_6$, and not

$C_{32}H_{28}O_{12}$, as previously suspected by the formation of the alkali salts, $C_{32}H_{27}O_{12}K$ and $C_{32}H_{27}O_{12}Na$ (Trans., 1898, **31**, 1031). *Benzoylcurcumin* (yellow needles, m. p. 176—178°) in a similar manner gave results in harmony with Ciamician and Silber's formula, $C_{21}H_{20}O_6$, (*Ber.*, 1897, **30**, 192) for curcumin.

171. "The estimation of methyl alcohol in presence of ethyl alcohol." By T. E. Thorpe and J. Holmes.

The authors described a method of estimating the amount of methyl alcohol in mixtures of methyl and ethyl alcohols based on the different modes of action of a mixture of potassium dichromate and sulphuric acid on the two alcohols. The method differs from that already described by Dupré, in 1876, in which the amount of acetic acid formed is taken as a measure of the amount of ethyl alcohol present, in that the amount of carbon dioxide evolved is weighed.

The authors described how their method is applicable to the case of the methylated spirit of commerce, and to the detection and determination of methylated spirit in tinctures and medicinal preparations suspected to contain it.

172. "Separation and estimation of silver cyanide and silver chloride." By R. H. A. Plimmer.

Freshly precipitated silver cyanide, although insoluble in cold dilute nitric acid, readily dissolves in the boiling acid, evolving the theoretical quantity of hydrogen cyanide, so that the gas, when passed into silver nitrate solution, produces an amount of silver cyanide equal in weight to the sample originally employed. In this way, silver cyanide may be quantitatively separated from silver chloride. When the cyanide has been dried at 100°, the hard lumps produced offer a greater resistance to the solvent, and if the boiling is prolonged the acid, on becoming more concentrated, oxidises a small proportion of the hydrogen cyanide.

173. "Estimation of hydroxyl radicles." By H. Hibbert and J. J. Sudborough.

In attempting to determine hydroxyl groups by Tschugaeff's method (*Ber.*, 1902, **35**, 3912), the authors have not succeeded in obtaining satisfactory results, owing to the following causes: (1) moisture gradually penetrates through the india-rubber, even although this is coated with collodion. (2) The vapour pressure of ether varies so enormously with slight alterations of temperature. (3) Grignard's magnesium methyl iodide solution slowly absorbs atmospheric oxygen.

The following method is free from the foregoing objections; dry amyl ether is used as the medium instead of ordinary ether, and the operation is carried out in an ordinary bottle provided with a double bored india-rubber stopper, so that the bottle may be attached to (1) a Lunge's nitrometer filled with dry mercury, (2) a glass tube provided with a stopcock, so that the air in the apparatus may be replaced by dry nitrogen. The amyl ether solution of the hydroxyl compound is placed in the bottle and a solution of Grignard's magnesium methyl iodide in the same solvent is introduced in a small tube; when a constant temperature has been attained, the two solutions are mixed.

Satisfactory results have been obtained with α- and β-naphthols, resorcinol, *o*-nitrophenol, acetoxime, deoxybenzoin and chloral hydrate.

Quinol gives somewhat low results, probably owing to the fact that it is only sparingly soluble in amyl ether.

174. "Diortho-substituted benzoic acids. Part V. Formation of salts from diortho-substituted benzoic acids and organic bases." By J. J. Sudborough and W. Roberts.

Since the publication of Part IV (*Trans.*, 1899, **75**, 580), E. Fischer has shown (*Ber.*, 1900, **33**, 345, 1967) that diortho-substituted tertiary bases of the type of dimethylmesidine are incapable of forming quaternary ammonium salts. The authors have prepared several mono- and diortho-substituted tertiary amines, and find that these are capable of combining with strong diortho-substituted benzoic acids, for example, *s*-trinitrobenzoic and 2 : 4 : 6-tribromo-3-aminobenzoic acids, but will not unite with feeble acids like 2 : 4 : 6-trimethylbenzoic and *o*-toluic acids.

In addition to the ordinary normal salts (1 mol. acid + 1 mol. base), acid salts of the type (2 mols. acid + 1 mol. base) derived from monobasic acids and monoacidic bases have been obtained. Many of these salts can be analysed by direct titration in alcoholic solution with standard barium hydroxide solution, using phenolphthalein as the indicator.

175. "*cis*-π-Camphanates of *d*- and *l*-hydrindamines." By F. S. Kipping.

cis-π-Camphanic acid gives with *dl*-hydrindamine two isomeric salts melting at 173° and 193° respectively, but which have the same specific rotation in aqueous solution (Trans., 1900, **77**, 903).

Having recently succeeded in resolving the *dl*-base (*Trans.*, 1903, **83**, 873), the author examined the *cis*-π-camphanates of the *d*- and of the *l*-base, partly to prove that the compounds previously described are really partially racemic, and partly to ascertain whether each of the optically active bases gives isomeric salts.

d-Hydrindamine *cis*-π-camphanate, obtained by combining the acid with the base from pure *d*-hydrindamine *d*-bromocamphorsulphonate, crystallises from water and alcohol in long needles and melts at about 181°; when fractionally crystallised from aqueous alcohol, the final mother liquors yield fractions which melt very indefinitely at 170—175°; the specific rotation of various fractions of this salt, examined in 2 per cent. methyl alcoholic solution, varied from $[\alpha]_D -7{\cdot}8°$ to $-17{\cdot}8°$.

l-Hydrindamine *cis*-π-camphanate, prepared from the base contained in pure *l*-hydrindamine *d*-bromocamphorsulphonate, closely resembles the salt of the *d*-base, but the original preparation melts indefinitely at 186—191°; when crystallised fractionally from aqueous alcohol, it yields portions melting as low as 180—184°. The specific rotation of fractions of this salt, determined in 2 per cent. methyl alcoholic solutions, varied from $[\alpha]_D -6°$ to $+7°$.

These observations seem to justify the conclusion that each base gives two isomeric salts, which, when the *dl*-base is used, combine in pairs to form the two partially racemic compounds previously described. The whole of the *cis*-π-camphanic acid used in these and in previous experiments was collected and crystallised fractionally from alcohol; the first and last fractions crystallised in identical forms, namely, characteristic hexagonal plates (*Trans.*, 1896, **69**, 943), melted simultaneously, and had the same specific rotation in alcoholic solution.

176. "Resolution of *dl*-methylhydrindamine." By G. Tattersall.

In resolving *dl*-methylhydrindamine into its enantiomorphously related components by the use of *d*-bromocamphorsulphonic acid (*Trans.*, 1903, **83**, 918), the yield of salts of the *d*- and *l*-bases was always small, and the author, at Dr. Kipping's suggestion, attempted to find a more satisfactory process for the resolution of this *dl*-base.

Experiments then showed that *d*-tartaric acid, used so as to form the hydrogen tartrates of the base, effected an excellent separation of the *d*- and *l*-bases by crystallising the salt at the ordinary temperature. The most sparingly soluble fractions contained the hydrogen tartrate of the *d*-base. The purification of the bases was effected by converting the first fractions, containing chiefly the *d*-base (about one-third of the whole), and the last fractions separately into the *d*-bromocamphorsulphonates, and finally fractionating from water.

d-*Methylhydrindamine hydrogen tartrate*, $C_{10}H_{13}N,C_4H_6O_6,2H_2O$, crystallises from water in long, glassy prisms; it melts at 153—155°

with slight decomposition. In aqueous solution, it has a specific rotation $[\alpha]_D$ +33° and molecular rotation $[M]_D$ +99°.

l-*Methylhydrindamine hydrogen tartrate*, $C_{10}H_{13}N,C_4H_6O_6$, crystallises from water in aggregates of small, glassy prisms; it melts at 197° with slight decomposition. In aqueous solution, its specific rotation is $[\alpha]_D -5°$ and its molecular rotation $[M]_D -14·8°$.

177. "Isomeric salts of *d*- and *l*-methylhydrindamines with *d*-chlorocamphorsulphonic acid." By G. Tattersall.

In a recent communication (Tattersall and Kipping, *Trans.*, 1903, **83**, 918), the formation of isomeric salts by the combination of *d*- and *l*-methylhydrindamines with *d*-bromocamphorsulphonic acid has been described, and similar experiments have now been made with the same bases and *d*-chlorocamphorsulphonic acid.

The salt of each base was made from carefully purified material and subjected to prolonged fractional crystallisation; the end fractions were then examined. In the cases of both the *d*- and *l*-bases, the melting points of the successive fractions gradually fell from the first to the last fractions, this behaviour being also observed with the *d*-bromocamphorsulphonate.

The chlorocamphorsulphonates differ, however, from the bromocamphorsulphonates in their optical behaviour. With the former acid, the specific rotations of the last fractions are higher than those of the first fractions, whereas with the latter acid the opposite was the case. The statement is true for both aqueous and chloroform solutions.

The results obtained are summarised in the following table:

l-*Methylhydrindamine* d-*chlorocamphorsulphonate.*

		$[\alpha]_D$.	
	m. p.	In chloroform.	In water.
First fraction	239°	+3·3°	+34·2°
Last ,,	231—233°	8·0	35·8

d-*Methylhydrindamine* d-*chlorocamphorsulphonate.*

		$[\alpha]_D$.	
	m. p.	In chloroform.	In water.
First fraction	247°	+56°	+60°
Last ,,	225—230°	63	63

Both salts crystallise in anhydrous needles.

Similar results were obtained with hydrindamine *d*-chlorocamphorsulphonates (Kipping, *Trans.*, 1903, **83**, 902), but in this case it was found impossible to isolate the isomeride of higher specific rotation.

178. "The four optically isomeric *l*-menthylamines and their salts."

By F. Tutin and F. S. Kipping.

The principal object of this research was to ascertain whether *l*-menthylamine would give, with *d*-bromocamphorsulphonic acid, isomeric salts analogous to those obtained by combining this acid with the optically active hydrindamines (*Trans.*, 1903, **83**, 873) and methylhydrindamines (*loc. cit.*, p. 918); for this purpose, it was first necessary to obtain the *l*-menthylamine free from optical isomerides. An examination of the menthylamine prepared by reducing the oxime of "*l*-menthone" showed that the crude basic product was a mixture of four optically isomeric active bases, and that the menthylamine obtained by heating "*l*-menthone" with ammonium formate was likewise composed of these four isomerides.

The explanation of these facts is afforded by a consideration of the optical configuration of *l*-menthone—a ketone which readily undergoes partial racemisation—and also of the reactions by means of which it is transformed into the base.

Since the four isomerides in question are derivatives of *l*-menthone (− −) and of *iso*-*l*-menthone (+ −), they are distinguished as *l*-menthylamine, neo-*l*-menthylamine, *iso*-*l*-menthylamine (*d*-menthylamine in the literature), and *iso*neo-*l*-menthylamine respectively.

l-Menthylamine combines with *d*-bromocamphorsulphonic acid giving a mixture of isomeric salts. One of these compounds can be obtained in a pure condition by repeated fractional crystallisation from water; it melts at about 226° and has a specific rotation $[\alpha]_D + 43{\cdot}7^\circ$ in aqueous, and $[\alpha]_D + 48{\cdot}7^\circ$ in chloroform solution. The isomeric salt cannot be obtained in a pure condition, but its presence is conclusively proved by the fact that the more readily soluble fractions melt at about 221° and have a specific rotation $[\alpha]_D + 38{\cdot}8^\circ$ in aqueous, and $[\alpha]_D + 42{\cdot}8^\circ$ in chloroform solution.

For the separation of the four isomeric *l*-menthylamines in the crude base, their hydrochlorides, *d*-bromocamphorsulphonates, and *d*-camphorsulphonates were fractionally crystallised, and also their formyl derivatives; *l*-menthylamine is thus isolated without difficulty, but for the separation of the other three isomerides, fractional crystallisation of their benzoyl derivatives was found to give the best results.

The following compounds are described :—

	l-Base.		neo-*l*-Base.		*iso*-*l*-Base.		*iso*neo-*l*-Base.	
	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.
d-Bromocamphorsulphonate.	226°	+43·2°	70—75° ?	—	166°	+65°	—	—
d-Camphorsulphonate.........	158	−5·3	188	+11·8°	177	+21·7	—	—
Benzoyl derivative	156	−61·9	128	−17·4	121	+22·7	104°	−3·8°

The specific rotations of the salts were determined in aqueous solutions, those of the benzoyl derivatives in chloroform.

179. "Preparation of the tetra-alkyl derivatives of stannimethane." By W. J. Pope and S. J. Peachey.

The preparation of the mixed tetra-alkylstannimethanes by the action of a zinc alkyl upon a trialkylstannimethyl iodide is difficult to carry out owing to the occurrence of secondary reactions, which greatly diminish the yield of the desired product. The authors have found that the magnesium alkyl iodides, bromides, and chlorides prepared by the method given by Grignard react vigorously with stannic chloride or with the mono-, di-, and tri-alkylstannimethane halogen derivatives, giving rise to the corresponding tetra-alkylstannimethanes. After treating the product with water, the tetra-alkyl derivative is readily separated in a state of purity by fractional distillation of the ethereal solution.

Tetraethylstannimethane, $SnEt_4$, is prepared by adding stannic chloride (1 mol.), dissolved in light petroleum, to the ethereal solution of magnesium ethyl bromide (4·5 mols.), washing with dilute acetic acid and distilling the ethereal solution; it boils at 180—181° under 758 mm. pressure.

Dimethyldiethylstannimethane, $SnMe_2Et_2$, may be prepared either by the action of magnesium methyl iodide on diethylstannimethylene chloride, bromide, or iodide, or by that of magnesium ethyl bromide on dimethylstannimethylene chloride, bromide, or iodide in ethereal solution. After treating with water and distilling the ethereal solution, the substance is obtained as a colourless liquid identical with that prepared by Frankland's method.

Trimethylethylstannimethane, $SnMe_3Et$, is obtained by treating trimethylstannimethyl bromide or iodide with the calculated quantity of magnesium ethyl bromide in ethereal solution, washing with dilute acetic acid, and fractionally distilling the ethereal solution; it boils at 107—108 under 758 mm. pressure.

Trimethylpropylstannimethane, $SnMe_3Pr^a$, is similarly prepared by the action of magnesium propyl bromide or iodide on trimethylstannimethyl bromide and forms a colourless liquid boiling at 129° under 764 mm. pressure. Triethylpropylstannimethane, $SnEt_3Pr^a$, from triethylstannimethyl bromide, boils at 195° under 764 mm. pressure.

Dimethylethylpropylstannimethane, $SnMe_2EtPr^a$, prepared by the action of propyl magnesium bromide or iodide on dimethylethylstannimethyl bromide, boils at 153° under 762 mm. pressure.

Methylethyldipropylstannimethane, $SnMeEtPr^a{}_2$, obtained from methylethylstannimethylene iodide and magnesium propyl bromide, is a colourless liquid boiling at 183—184° under 758 mm. pressure.

Tetraphenylstannimethane, $SnPh_4$, is conveniently prepared by the action of stannic chloride on magnesium phenyl bromide.

The further study of the mixed alkylstannimethanes, prepared by aid of the above reaction, is being continued, together with the examination of the action of the magnesium alkyl salts on silicon tetrachloride.

180. "Optically active esters of β-ketonic and β-aldehydic acids. Part IV. Condensation of aldehydes with menthyl acetoacetate." By A. C. O. Hann and A. Lapworth.

Menthyl acetoacetate condenses readily with aldehydes in presence of bases, and the following products have been obtained.

Dimenthyl ethylidenebisacetoacetate, $CHMe(CHAc\cdot CO_2\cdot C_{10}H_{19})_2$, produced when acetaldehyde is used, forms fine needles melting at 194—196° and has $[\alpha]_D - 24\cdot 9°$ in benzene, a very slight mutarotation being noticed.

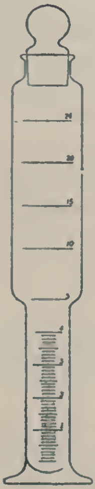
Menthyl n-*propylideneacetoacetate*, $CHEt{:}CAc\cdot CO_2\cdot C_{10}H_{19}$, is formed at the ordinary temperature, crystallises in glistening, elongated plates or needles, melts at 84—88°, and has $[\alpha]_D - 34\cdot 9°$. It condenses with menthyl acetoacetate to form *dimenthyl* n-*propylidenebisacetoacetate*, $CHEt(CHAc\cdot CO_2\cdot C_{10}H_{19})_2$, which melts at 201—207° and has $[\alpha]_D - 26\cdot 9°$.

Dimenthyl n-*butylidenebisacetoacetate*, $CHPr^a(CHAc\cdot CO_2\cdot C_{10}H_{19})_2$, melts at about 184° and has $[\alpha]_D - 16\cdot 8°$. *Dimenthyl* iso*butylidenebisacetoacetate*, $CHPr^\beta(CHAc\cdot CO_2\cdot C_{10}H_{19})$, melts at 193—202°; in benzene solution, it has $[\alpha]_D - 42\cdot 6°$, changing slowly to $[\alpha]_D - 46\cdot 0°$.

Menthyl benzylideneacetoacetate, $CHPh{:}CAc\cdot CO_2\cdot C_{10}H_{19}$, crystallises in well-formed, glistening plates melting at 133—134°; in benzene solution, $[\alpha]_D - 10\cdot 0$. With menthyl acetoacetate, it yields *menthyl benzylidenebisacetoacetate*, $CHPh(CHAc\cdot CO_2\cdot C_{10}H_{19})_2$, which melts at 203—206° and has $[\alpha]_D - 30\cdot 4°$.

The formula usually ascribed to the monoalkylidene derivatives of β-ketonic esters does not readily account for the abnormally low values of their rotatory powers.

The statement that tertiary bases are not effective in bringing about the condensation of aldehydes with β-ketonic esters is incorrect; the very feeble tertiary bases, pyridine, quinoline, or dimethylaniline are useless, but trimethylamine and tripropylamine may be employed, although these are not so rapid in their action as the still more powerful secondary bases, such as diethylamine or piperidine.



181. "Estimation of the adulterant in citronella oil."

By M. K. Bamber.

A mixture of 2 c.c. of pure cocoanut oil free from acid and 2 c.c. of the citronella oil under examination is shaken for one minute with 20 c.c. of 83 per cent. alcohol (sp. gr. 0·8273 at 30°) in the graduated tube (see Figure), this vessel being then rotated in a centrifugal machine for 0·5 to 1·0 minute. The volume of cocoanut oil, which now contains the impurity originally present in the citronella oil, is ascertained, and this reading minus 2 c.c. represents the adulterant. For example, 2·45 c.c. of residual oil represent 0·45 c.c. of impurity in the 2 c.c. of citronella oil or an adulteration of 22·5 per cent. A standard oil should be tested occasionally against the unknown samples in order to eliminate errors arising from the use of alcohol of different strengths.

In this way, the adulterant is separated and estimated in 3 or 4 minutes, the test being conducted at 29—30°.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Kohut, Adolph. Justus von Liebig. Sein Leben und Wirken. pp. 394. ill. Giessen 1904.

Posner, Theodor. Lehrbuch der synthetischen Methoden der organischen Chemie. pp. xxxii + 436. Leipzig 1903.

Schucht, Ludwig. Die Fabrikation des Superphosphats mit Berücksichtigung der anderen gebräuchlichen Düngemittel. Handbuch für den Düngerchemiker im Betriebe und im Laboratorium. 2 Aufl. pp. 336. ill. Braunschweig 1903.

Weber, Carl Otto. The chemistry of india-rubber, including the theory of vulcanisation. pp. xii + 314. ill. London 1902.

III. *Pamphlets.*

Cross, C. F., Bevan, E. J., Beadle, Clayton, and Sindall, R.W. C.B.S. Units and standard paper tests. An essay towards establishing a normal system of paper testing. pp. 25. London 1903.

Golding, John. A domesticated microbe. (*From the Proc. Nottingham Naturalist's Society*, 1903.)

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Rideal, Samuel, and Walker, T. Ainslie. Standardisation of disinfectants. (*From the Journal of the Sanitary Institute*, **24**, 3.)

Schaer, Ed. Ueber die Verwendung des Chloralhydrates bei Drogen- und Nahrungsmittel-prüfungen, toxikologisch-chemischen Untersuchungen und technischen Expertisen. (*From the Berichte der Deutschen Pharmaceutischen Gesellschaft*, 1903, *Hft.* 6.)

Wells, Henry M. Cylinder oil and cylinder lubrication. Part I. (*From the Engineer, July* 17 and 31, *August* 7 and 14, 1903.)

At the next meeting, January 20th, 1904, at 5.30 p.m., the following papers will be communicated:—

"The chemical reactions of nickel carbonyl. Part I." By J. Dewar and H. O. Jones.

"The chemical reactions of nickel carbonyl. Part II. Reaction with aromatic hydrocarbons in presence of aluminium chloride. Synthesis of aldehydes and anthracene derivatives." By J. Dewar and H. O. Jones.

"Optically active asymmetric nitrogen compounds, *d*- and *l*-phenylmethylethylamine salts." By H. O. Jones.

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CHARTER

AND

BYE-LAWS

OF

THE CHEMICAL SOCIETY.

BURLINGTON HOUSE,
London, W.
1903.

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THE CHEMICAL SOCIETY.

ORIGIN AND FORMATION.

A MEETING, convened by Mr. Warington for the purpose of taking into consideration the formation of a Chemical Society, was held in the rooms of the Society of Arts, John-street, Adelphi, on February 23rd, 1841, at which the following gentlemen were present:—Arthur Aikin, Esq., Dr. Thos. Clark, W. J. Cock, Esq., J. T. Cooper, Esq., D. Cooper, Esq., Thos. Everitt, Esq., Wm. Ferguson, Esq., J. P. Gassiot, Esq., Thos. Graham, Esq., W. R. Grove, Esq., H. Hennell, Esq., T. H. Henry, Esq., C. Heisch, Esq., G. Lowe, Esq., W. H. Miller, Esq., Apsley Pellatt, Esq., Richard Phillips, Esq., Dr. Lyon Playfair, Robert Porrett, Esq., Dr. G. O. Rees, E. Solly, Jun., Esq., James Tennant, Esq., E. F. Teschemacher, Esq., Dr. R. D. Thomson, and Robert Warington, Esq.

Professor Graham having been called to the Chair, it was unanimously resolved, "That it is expedient that a Chemical Society should be formed," and a Provisional Committee, consisting of Messrs. A. Aikin, W. T. Brande, H. J. Brooke, J. T. Cooper, Rev. J. Cumming, J. F. Daniell, T. Everitt, T. Graham, W. R. Grove, H. Hennell, G. Lowe, R. Phillips, R. Porrett, and R. Warington, was appointed to carry this resolution into effect.

The objects of the Society were defined to be—

> "The promotion of Chemistry and of those branches of Science immediately connected with it, by the reading, discussion, and subsequent publication, of original communications."

> "Also the formation of a Chemical Library, and Museum."
>
> "It was proposed that the Annual Subscription for Members resident within twenty miles of London, should be Two Pounds; beyond that distance, One Pound."

At the first General Meeting, held on the 30th of March, 1841, the Provisional Committee brought forward a Report, embodying a plan for the constitution and government of the Society. The Report, with some amendments, was adopted by the Meeting.

The following gentlemen were then elected as the first Officers and Council:—President—T. Graham, Esq.; Vice-Presidents—W. T. Brande, Esq., J. T. Cooper, Esq., J. F. Daniell, Esq., R. Phillips, Esq.; Treasurer—Arthur Aikin, Esq.; Secretaries—Robert Warington, Esq., E. F. Teschemacher, Esq.; Council—Dr. T. Clark, Rev. J. Cumming, M.A., Dr. C. Daubeny, T. Everitt, Esq., T. Griffiths, Esq., W. R. Grove, Esq., H. Hennell, Esq., G. Lowe, Esq., W. H. Miller, Esq., M.A., W. H. Pepys, Esq., R. Porrett, Esq., Dr. G. O. Rees. The names of seventy-seven gentlemen who had become Members were then read, and the Society adjourned until Tuesday, the 13th of April.

The Society continued to meet regularly, from time to time, and published Memoirs and Reports of their Proceedings, which at the close of the year 1847 amounted to three volumes.

As the Members of the Society at this time amounted to between 200 and 300, it appeared desirable that steps should be taken for obtaining a Charter of Incorporation; and, at the Anniversary Meeting for 1848, a Resolution was passed—

> "That it be recommended to the Council for their consideration, whether it would be for the interests of the Society to procure a Charter of Incorporation."

In pursuance of this Resolution, the Council made the necessary inquiries, and a Special Meeting of the Society was summoned on the 22nd of May, 1848, to receive their Report, in which the Council advised the Society to make application to Government for a Charter. The Report was adopted by the Meeting, and it was resolved—

> "That this Meeting do authorise the Council to take the necessary steps for procuring a Charter of Incorporation."

Application was therefore made to the Government authorities in due form, and the Royal assent having been obtained, the Society was incorporated under the following Charter.

CHARTER.

VICTORIA, by the Grace of God of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith, to all to whom these presents shall come greeting WHEREAS WILLIAM THOMAS BRANDE, of our Mint, Esquire, a Fellow of the Royal Society and of the University of London, and others of our loving subjects, did in the year 1841 establish, and are now Members of, a Society known by the name of the Chemical Society, for the general advancement of Chemical Science, as intimately connected with the prosperity of the manufactures of the United Kingdom, many of which mainly depend on the application of chemical principles and discoveries for their beneficial development, and for a more extended and economical application of the industrial resources and sanatory condition of the community: AND WHEREAS it has been farther represented to us that the same Society has, since its establishment, sedulously pursued such its proposed object, by holding meetings at stated periods, at which new discoveries have been brought under discussion, and the results made known to the public in a series of Transactions from time to time published by the said Society, and that distinguished individuals in foreign countries have availed themselves of the facilities offered by the same Society for communicating important scientific and practical discoveries made abroad, and that thus a useful interchange of valuable information has been effected: AND WHEREAS the same Society has hitherto been supported by donations and annual and other subscriptions and contributions to its funds, and has expended and continues to expend considerable sums of money in the publication of its Transactions, in aid of which objects a Library of scientific works, and also a Museum of chemical preparations and standard instruments are in course of being formed: AND WHEREAS, in order to secure the property of the said Society, and to extend its useful operations, and at the same time to give it a more permanent establishment among the scientific institutions of our kingdom, WE have been besought to grant to the said WILLIAM THOMAS BRANDE, and to those who now are or shall hereafter become Members of the said Society, our Royal Charter of Incorporation for the purposes aforesaid:—

NOW KNOW YE, that we being desirous of encouraging a design so laudable and salutary of our especial grace, certain knowledge, and mere motion, have willed, granted, and declared, and do by these presents, for us, our heirs and successors, will, grant, and declare, that the said WILLIAM THOMAS BRANDE, and such others of our loving subjects as now are Members of the said Society, or shall from time to time be elected Fellows thereof, according to such regulations or bye-laws as shall be hereafter framed or enacted, and their successors shall for ever hereafter be, by virtue of these presents, one body politic and corporate by the name of THE CHEMICAL SOCIETY, and for the purposes aforesaid, and by the name aforesaid shall have perpetual succession and a Common Seal, with full power and authority to alter, vary, break, and renew the same at their discretion, and by the same name to sue and be sued, implead and be impleaded, answer and be answered unto in every court of us, our heirs and successors, and be for ever able and capable in the law to purchase, receive, possess, hold, and enjoy, to them and their successors, any goods and chattels whatsoever; and also to be able and capable in the law (notwithstanding the statutes of mortmain) to take, purchase, possess, hold, and enjoy to them and their successors, a hall or house and any such messuages, lands, tenements, or hereditaments whatsoever, as may be necessary for carrying out the purposes of the Society, the yearly value of which, including the site of the said hall or house, shall not exceed in the whole the sum of £3,000, computing the same respectively at the rack-rent which might have been had or gotten for the same respectively at the time of the purchase or acquisition thereof; and to act in all the concerns of the said body politic and corporate for the purposes aforesaid, as fully and effectually to all intents, effects, constructions, and purposes whatsoever, as any other of our liege subjects or any other body politic in our United Kingdom of Great Britain and Ireland, not being under any disability, might do their respective concerns; AND WE DO HEREBY GRANT our especial licence and authority unto all and every person and persons, bodies politic and corporate otherwise competent to grant, sell, alien, and convey in mortmain, unto and to the use of the said body politic and corporate and their successors, any messuages, lands, tenements, or hereditaments, not exceeding such annual value as aforesaid:

AND OUR WILL AND PLEASURE IS, AND WE FURTHER GRANT AND DECLARE, that there shall be a General Meeting or General Meetings of the Fellows of the said Society, to be held from time to time as hereinafter mentioned, and that there shall be a Council to direct and manage the concerns of the said body politic and corporate, and that the General Meetings and the Council shall have the entire direction and management of the same, in the manner and subject to the regulations hereinafter mentioned: BUT OUR WILL AND PLEASURE IS that at all General Meetings and Meetings of the Council the majority present and having a right to vote thereat respectively shall decide upon the matters propounded at such Meetings, the person presiding therein having, in case of an equality of numbers, a second or casting vote:

AND WE DO HEREBY ALSO WILL, GRANT, AND DECLARE, that there shall be a President, Vice-Presidents, a Treasurer and Secretaries of the said body politic and corporate, and that the Council shall consist of the President, Vice-Presidents, Treasurer, Secretaries, and not more than twelve nor less than eight other Fellows of the said Society; AND WE DO HEREBY FURTHER WILL AND DECLARE, that the said WILLIAM THOMAS BRANDE shall be the first PRESIDENT of the said body politic and corporate, and the other persons now being the Vice-Presidents, Treasurer, Secretaries, and other Members of the Council, shall be the first Members of the Council of the said body politic and corporate, and shall continue such until the election of Officers shall be made in pursuance of these presents:

AND WE DO HEREBY FURTHER WILL AND DECLARE, that it shall be lawful for the Fellows of the said body politic and corporate hereby established to hold a General Meeting once in the year or oftener, for the purposes hereinafter mentioned, namely, that the President, Vice-Presidents, the Treasurer, the Secretaries, and other Members of the Council, shall be chosen at such General Meeting; and that the General Meetings shall from time to time make and establish such bye-laws as they shall deem to be useful and necessary for the regulation of the said body politic and corporate, for the admission of Fellows, the election of Associates, and of Honorary and Foreign Members, and for the management of the estates, goods and business of the said body politic and corporate, for fixing and determining the number of Vice-Presidents, Secretaries, and the number of the other Members of the Council as aforesaid, and the time and manner of electing the President, Vice-Presidents, Treasurer, Secretaries, and other Members of the Council, and the period of their respective continuance in office; and such bye-laws from time to time they shall or may alter, vary, or revoke, and shall or may make such new and other bye-laws as they shall think most useful and expedient for the said body politic and corporate, so that the same be not repugnant to these presents or to the laws and statutes of this our realm, and shall and may also enter into any resolution, and make any regulation respecting any of the affairs and concerns of the said body politic and corporate that shall be thought necessary and proper:

AND WE DO FURTHER WILL AND DECLARE, that the first such General Meeting as aforesaid for the election of officers shall take place within twelve calendar months from the date of these presents, and that the present rules and regulations of the said Society, so far as they are not inconsistent with these presents, shall continue in force until the same shall be altered by a General Meeting:

AND WE FURTHER WILL, GRANT, AND DECLARE, that the Council shall have the sole management of the income and funds of the said body politic and corporate, and the appointment of an Assistant-Secretary, Librarian, Curator, and such other officers, attendants, and servants as shall in the discretion of the Council be deemed necessary or useful for the said Society, as also the entire management and superintendence of all the other affairs and concerns thereof, and shall and may, but not inconsistent with or contrary to the provisions of this our Charter, or any existing bye-law, or laws and statutes of this our realm, do all such acts and deeds as shall appear to them necessary or essential to be done for the purpose of carrying into effect the objects and views of the said body politic and corporate; PROVIDED ALWAYS, AND WE

DO WILL AND DECLARE, that the Council shall from time to time render to a General Meeting a full and particular account of all such their proceedings as aforesaid, and that it shall be lawful for every Fellow of the said Society to see and examine the accounts of the receipts and payments of the said body politic and corporate:

AND WE FURTHER WILL, GRANT, AND DECLARE, that the whole property of the said body politic and corporate shall be vested, and we do hereby vest the same, solely and absolutely, in the Fellows thereof, and that they shall have full power and authority to sell, alienate, charge, and otherwise dispose of the same as they shall think proper; but that no sale, mortgage, incumbrance, or other disposition of any messuages, lands, tenements, or hereditaments belonging to the said body politic and corporate, shall be made, except with the approbation and concurrence of a General Meeting:

AND WE DO HEREBY FURTHER WILL AND DECLARE, that the service of the President, Vice-Presidents, Treasurer, Secretaries, and other Members of the Council, shall be honorary, and that it shall not be lawful for them, or any of them, to receive any pecuniary payment for their attendance or other services in or about the affairs of the said body politic and corporate, and that no dividend, gift, division, or bonus in money, shall be made out of the funds of the said body politic or corporate, unto or among any of its Fellows:

AND WE LASTLY DECLARE it to be our Royal will and pleasure, that no resolution or bye-law shall on any account or pretence whatsoever be made by the said body politic and corporate in opposition to the general scope, true intent and meaning of this our Charter, or the laws or statutes of our realm; and that if any such rule or bye-law shall be made, the same shall be absolutely null and void to all intents, effects, constructions, and purposes whatsoever. IN WITNESS whereof we have caused these our Letters to be made Patent. WITNESS ourself at our Palace at Westminster, this Second day of November, in the 12th year of our Reign.

By Writ of Privy Seal,
EDMUNDS,

L. S.

In accordance with the preceding Royal Charter, the Chemical Society consists of Fellows, Honorary and Foreign Members and Associates.

The Fellows elect, out of their own body, according to the following Rules, a Council consisting of a President, four or more Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted in conformity with the following bye-laws.

BYE-LAWS.

I.—*Of the Election, Admission, and Payments by Fellows.*

THE method of voting for the election of Fellows shall be by ballot.

Every Candidate for election into the Society as a Fellow thereof shall be proposed according to a form of recommendation (see Appendix No. 1) subscribed by not less than five Fellows of the Society, to three, at least, of whom he shall be personally known; and the name of each Candidate shall be read at three Ordinary Scientific Meetings, and such certificates shall be published in full in the Society's Proceedings and suspended in the Society's rooms or place of meeting, until the Candidate has been duly balloted for.

That in the case of Candidates resident abroad unable to obtain the before-mentioned number of signatures, the Council shall have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

Ballots shall take place at Ordinary Scientific Meetings and those Candidates shall be balloted for whose certificates have been read at two previous Ordinary Scientific Meetings, and again on the evening of the ballot.

The election shall not be valid unless thirty-two or more Fellows vote ; but if an insufficient number of votes be recorded, the particular Candidate or Candidates put up for Ballot shall be again balloted for at the next Meeting or Meetings. When three-fourths or more of the Fellows who vote are in favour of the Candidate, he shall be elected a Fellow; but when less than three-fourths of the Fellows who vote are in favour of the Candidate, he shall not be elected a Fellow. The result of the ballot shall be ascertained by two Scrutators and one of the Secretaries, and declared by the Chairman.

The Fellow thus elected shall sign the following obligation, and return it to the Secretary:—" I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Chemical Society; that I will observe its laws, and to the utmost of my power, maintain its dignity, as long as I shall continue a Fellow thereof." This obligation records his acquiescence in all the Rules, Regulations, and Laws of the Society, and pledges him to their due observance.

The formal admission of Fellows shall take place after the reading of the Minutes at Ordinary Scientific Meetings of the Society.—After the reading aloud by one of the officers of the prescribed form of obligation, the Fellow to be admitted shall subscribe his name to the obligation in the Charter-book, and be introduced to the Chairman, who, taking him by the hand, shall say:—" Mr. ———, I do, by the authority and in the name of the Chemical Society, admit you a Fellow thereof."

Every Fellow shall have the right to be present and to vote at all Meetings of the Society; and to propose Candidates for admission into the Society; and he shall be entitled, so long as his annual subscription be not in arrear, to one copy of the annual publications of the Society. He shall also be entitled to the use of the instruments and books in the Society's collection, under such restrictions as the Council may deem necessary. He shall have the privilege of introducing two visitors to the Ordinary Scientific Meetings of the Society, whose names shall be entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

Every Fellow, previous to his admission, shall, within three months from the date of his election, pay an admission fee of Four Pounds, and either his first annual subscription, or a life composition fee, otherwise his election shall be void; power to extend this period of three months being, however, reserved to the Council.

The annual subscription to be paid by Fellows shall be Two Pounds; excepting that those Fellows residing more than twenty miles from London, who shall have been elected before the 1st day of January, 1860, shall pay One Pound. The subscriptions of Fellows shall become due on the first day of January in every year.

If, however, a Candidate be elected during the month of November or December, he shall not be called upon to pay any annual subscription for the current year, and shall not be entitled to receive the publications of the Society for that year.

The life composition fee shall be Thirty Pounds, excepting that Fellows who have paid ten annual subscriptions shall pay as life composition fee Twenty Pounds; Fellows who have paid fifteen annual subscriptions shall pay Fifteen Pounds; Fellows who have paid twenty annual subscriptions shall pay Twelve Pounds; and Fellows who have paid twenty-five annual subscriptions shall pay Ten Pounds.

II.—*Of Honorary and Foreign Members.*

Honorary and Foreign Members shall be recommended to the Society by the Council. They shall be nominated at one Meeting of the Council, and shall be balloted for at some subsequent Meeting of the Council, and if the majority of those voting are in favour of any Candidate, he shall be proposed by the Council to the Society at a subsequent Ordinary Scientific Meeting, and be balloted for at the Ordinary Scientific Meeting of the Society following that at which he was recommended for election according to the Rules for the election of Fellows.

The number of Honorary and Foreign Members shall not exceed forty. The Honorary and Foreign Members shall not be required to contribute to the Funds of the Society. Each shall receive a copy of the annual publications of the Society.

III.—*Of Associates.*

Associates shall be recommended to the Society by the Council, and shall be balloted for in the same manner as Fellows. They shall be elected under the same conditions, but for a period of three years only, at the expiration of which time they may be again recommended for election.

Associates shall pay an annual subscription of One Pound. They shall have the ordinary privileges of Fellows, but shall neither vote in the Society nor propose Fellows, nor shall they be entitled to a gratuitous copy of the annual publications of the Society, but they shall have the option of paying an annual subscription of Thirty shillings in place of One Pound, for which higher subscription they shall be entitled to a copy of the Society's Journal, in addition to the ordinary privileges of Fellows, with the exceptions hereinbefore specified.

IV.—*Of the Withdrawing and Removal of Fellows and Associates.*

Any Fellow who at the period of the Annual General Meeting of the Society in March shall owe two annual subscriptions, such subscription having been applied for by Circular No. 4 in the Appendix, and no reason satisfactory to the President and Council having been assigned for their non-payment, shall cease to be a Fellow of the Society, and have his name removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person shall be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying up the arrears of his subscription, or a life composition fee.

Any proposition to remove a Fellow or Associate from the Society, for other causes than the non-payment of subscriptions, must be made by the Council. It shall be read at any Ordinary Scientific Meeting of the Society, and at the like Meeting next ensuing the proposition shall be balloted for, and if three-fourths of the Fellows voting shall vote for the removal of such Fellow or Associate, he shall be removed from the Society accordingly.

The ballot shall not be valid unless forty or more persons vote.

V.—*Of the Election of President, Officers, and Council.*

All Officers of the Society shall be elected by ballot at the Annual General Meeting, in March.

At the second Ordinary Scientific Meeting, in February, the Chairman shall declare: 1st. The names of the two Vice-Presidents who it is proposed should retire, either from the Council, or, in the event of one of them being nominated to the Presidency, from the Vice-Presidency.

2nd. The names of four ordinary Members of the Council who it is proposed should also retire. 3rd. The names of the President and officers recommended for election to office during the ensuing year, including the names of two new Vice-Presidents selected either from the existing Council, or from the General body of Fellows. 4th. The names of four new ordinary Members, recommended for election to the Council, or in the event of two ordinary Members of Council being nominated to the Vice-Presidency, of six new Members, or in the event of one ordinary Member of Council being nominated to the Vice-Presidency, of five new Members.

Two lists, according to the Forms Nos. 5 and 6 in the Appendix, with the names of the Fellows recommended for election as official and ordinary Members of Council, and having each a blank column opposite for such alterations as any Fellow may wish to make, shall be prepared by the Secretaries. These two lists shall be read from the Chair at the first Ordinary Scientific Meeting in March, and, on or before the day of meeting, shall be suspended in the Society's rooms and circulated among the Fellows.

In the event of any Fellow proposing some other name or names than those recommended by the Council, and communicating his proposal in writing, duly signed by himself, to one of the Secretaries before the second meeting in March, the same shall be read from the Chair, and be publicly suspended in the Society's rooms with the list recommended by the Council.

On the day of Election, two Scrutators shall be nominated by the Chairman, with the approbation of the Meeting, to assist the Secretaries in examining the lists. Each Fellow voting shall deliver his list to one of the Scrutators, and the name of the Fellow so voting shall be recorded by one of the Secretaries. The names of those reported to the Chairman by the Scrutators as having the majority of votes of the Fellows present, for filling the offices of President, Vice-Presidents, Treasurer, Secretaries, and Council, shall then be announced from the Chair, as elected to serve for the ensuing year.

In the event of votes being recorded for the same Candidate, both as an Officer and as a Member of Council, the votes recorded for him as an Officer shall, in the case of his not being elected an Officer, be added to those recorded for him as a Member of Council, and the total number of votes shall be counted as votes for the Council.

VI.—*Of the President.*

The President shall preside at the Meetings of the Society and of the Council, and shall regulate the order of the proceedings.

No Fellow shall be elected as President of the Society for more than two years in succession, but he may be re-elected after the lapse of one year.

In case of a casual vacancy, the Council shall name a Vice-President to exercise the powers and perform the duties of President.

VII.—*Of the Vice-Presidents.*

In the absence of the President, the Chair shall be occupied by one of the Vice-Presidents, or, in the absence of any Vice-President, by a Member of Council or some other Fellow.

Fellows who have filled the office of President at any time since the formation of the Society, shall be proposed by the Council for election as Vice-Presidents, and this proposition shall be renewed every year, excepting when any such Vice-President is again nominated to the Presidency. There shall be six other Vice-Presidents who have not filled the office of President, of whom two shall retire from the Council every year, unless one of the outgoing Vice-Presidents be nominated to the Presidency, when only one other Vice-President shall retire.

VIII.—*Of the Treasurer.*

The Treasurer shall receive all money due to the Society, and shall pay such sums as may be ordered by the Council. He shall keep an account of such receipts and payments, in which donations and money received for composition of annual payments shall be entered separately from the ordinary revenues of the Society, and he shall produce such account at any Meeting of the Council, when required.

The Treasurer shall pay the moneys received by him into the hands of the Society's banker, retaining a sum not exceeding £100 for the payment of current expenses.

The Treasurer shall, on the first day of January annually, send to every Fellow of the Society who has not compounded for his annual contribution, a printed copy of the Intimation contained in No. 3 in the Appendix; and in making up his Accounts in the month of March of every year for the examination of the Auditors, he shall present a list of all Fellows whose subscriptions are then in arrear.

At the second Ordinary Scientific Meeting of the Society in February, three Auditors shall be elected by the Society by show of hands, unless a ballot be demanded. They shall audit the Treasurer's Account, and shall forward their Report to the Council at least one week before the Annual General Meeting of the Society. They shall have the power of calling for all necessary accounts and vouchers. No member of the Council shall be eligible as an Auditor.

IX.—*Of the Secretaries.*

There shall be two Secretaries and a Foreign Secretary. The duties of the Secretaries shall be—1st. To attend, one or both, at all Meetings of the Society and of the Council. 2nd. To take minutes of the proceedings, and to read them at the ensuing Meeting. 3rd. To read all Scientific Communications to the Society, or abstracts thereof, that are not read by their respective authors. 4th. To address to every person elected into the Society a printed copy of the Letter No. 2 in the Appendix, and of the Obligation, together with a copy of the Bye-Laws of the Society, a List of the Fellows, and a Card announcing the days on which the Society holds its Meetings during the Session. 5th. To prepare and circulate the Balloting Lists of the Council. 6th. To conduct the home correspondence of the Society. A book shall be kept in the charge of the Secretaries, containing a copy of the Charter and Laws of the Society, with the form of Obligation to be subscribed by each Fellow. The several duties to be performed by each Secretary to be arranged by the Council.

The Foreign Secretary shall conduct the foreign correspondence of the Society.

X.—*Of the Council.*

The business of the Society shall be conducted by a Council, consisting of the President, the Vice-Presidents, the Treasurer, the Secretaries, and twelve other Fellows, not fewer than eight of whom shall, at the time of election, be resident within twenty miles of London. Annually four of the twelve ordinary Members of Council (three at least of whom must be resident Members) shall retire from the Council, and four new Members shall be elected to supply their places. At all Meetings of the Council five shall be a quorum.

The Council shall hold their Ordinary Meetings at least once a month, from November to June inclusive, on one of the days of the Ordinary Scientific Meetings of the Society. Notice of the time of holding each Meeting of the Council shall be forwarded by one of the Secretaries to each Member of the Council at least two days previous to that on which such Meeting is to be held, but the non-receipt of such notice by any Member of the Council shall in no way invalidate the proceedings of the Meeting.

Extraordinary Meetings of the Council shall be called by the President upon a requisition to him, signed by three Members of the Council, or at his own discretion, when he shall direct the Secretaries to issue summonses for the occasion.

The ordinary mode of decision on questions before the Council shall be by show of hands, unless a ballot be demanded. Any Member of the Council who shall be personally concerned in the question under consideration, shall retire during the discussion and determining of the same.

At the Annual General Meeting, the President shall present a Report on the state of the Society during the past twelve months.

Before any new Bye-Law, or alteration of the existing Bye-Laws, be brought before the Society by the Council, it shall be proposed at one Meeting of the Council, and considered and approved of at a subsequent Meeting.

The Council shall have the power of appointing and of removing the Assistant Secretary, Librarian, Curator, or other paid Officers of the Society.

XI.—*Of the Ordinary Scientific Meetings of the Society.*

The Ordinary Scientific Meetings of the Society shall be held twice in every month from November to

June inclusive, except in the month of January, when the Society shall meet once only, and also at Easter, when, if the Council see fit, there shall be only one meeting in the month: the specific days and hours of meeting to be determined by the Council. The ordinary course of business shall be as follows, subject, however, to the control of the Chairman for the time being:—1st. The names of the Visitors, and of the Fellows by whom they are introduced, shall be announced from the Chair. 2nd. The Minutes of the proceedings of the previous Meeting shall be read and submitted for confirmation. 3rd. New Fellows shall sign the obligation book, and shall be admitted by the Chairman. 4th. Presents made to the Society since its last Meeting shall be announced from the Chair. 5th. The certificates of Candidates for election shall be read. 6th. Scientific communications shall be read and discussed. 7th. The titles of papers ordered for reading at the next Meeting shall be announced.

XII.—*Of Annual General Meeting.*

An Annual General Meeting of the Society shall be held on the 30th day of March, or on some day in March near that time, and at such an hour as the Council may determine, for the election of Officers, &c.

XIII.—*Of the Extraordinary Meetings of the Society.*

An Extraordinary General Meeting of the Society shall be summoned at any time by the President, on his receiving a written requisition to do so from the Council, or from twenty Fellows of the Society. Notice shall be given of such Meeting at a previous Ordinary Scientific Meeting, or by a circular addressed to all the resident

Fellows. The President shall have the power of calling an Extraordinary General Meeting.

At all General Meetings of the Society, whether Annual or Extraordinary, no motion of a proposal to alter the Bye-laws shall be considered of which due notice has not been given at least fourteen days previously, either at an Ordinary Scientific Meeting, or through the Agency of the "Proceedings," or by means of a printed notice addressed to all the resident Fellows.

XIV.—*Of the Reading and Publication of Scientific Papers.*

The Secretary shall mark upon each paper sent to him the date on which he received it from the author, and also the date upon which it was read to the Society. These papers shall, as far as expedient, be read in the order in which they are received, and the discussion of each paper shall immediately follow the reading thereof, unless the Chairman for the time being shall otherwise direct. The discussion of any paper may, on a resolution of the meeting to that effect, be resumed at the following Meeting. Authors may read their own papers, by permission of the Chairman.

All papers communicated to the Society, with their illustrative Drawings, shall become the property of the Society, unless stipulation be made to the contrary; and authors shall not be at liberty, save by permission of the Council, to publish in English the papers they have communicated, until such papers, or abstracts of them, have either appeared in the Journal of the Society, or have been returned to the author.

The Journal of the Society shall be published at intervals to be determined by the Council. It shall consist of such of the papers which have been read at the

Meetings of the Society, or of abstracts of them, as the Council may determine, together with abstracts of papers published in other Journals.

If any paper of importance is communicated during the recess, the same may be ordered for publication by the Council, without being read to the Society.

The authors of such papers as may be published by the Society shall be entitled to fifty copies of each of their own papers free of expense.

XV.—*Of the Library.*

The books in the possession of the Society shall be allowed to circulate among the Fellows and Associates, under such regulations, and with such exceptions, as the Council may deem advisable.

XVI.—*Of the Common Seal and Deeds..*

The Common Seal of the Society shall remain in the custody of the President. Every Deed or Writing to which the Common Seal is to be affixed, shall be passed and sealed in Council.

APPENDIX.

No. 1.

CHEMICAL SOCIETY.

Certificate of a Candidate for Election.

The attention of the candidate in whose favour this certificate is made out is specially directed to the fact that, if elected, he will be required to sign the following obligation prior to his admission into the Society:—

> OBLIGATION.—I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the CHEMICAL SOCIETY, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue a Fellow thereof.

Name ______________________________

Usual Place of Residence ______________________________

Designation or Occupation ______________________________

Qualifications.*
____
____
____
____

being desirous of admission into the CHEMICAL SOCIETY, *we, the undersigned, propose and recommend him as a proper person to become a* FELLOW *thereof.*

---

* Directions for filling up the Certificate are given on the other side.

Dated this ____________ day of ______________ 19

From Personal Knowledge.	From General Knowledge.

Proposed on ____________________

To be Balloted for on ____________________

Elected ______________ 19

____

President.

Directions for filling up the Certificate of a Candidate.

Under "Qualifications" should be given a concise statement of the Candidate's contributions to Chemical Science as Investigator or Author, or of his position and past experience as Lecturer, Teacher, Assistant or Student or in connection with Analytical or Manufacturing Chemistry.

If the Candidate's qualifications are not included under any of the above heads, the reasons for his desiring admission to the Society should be stated.

The Certificate must be signed by *five* or more Fellows, of whom *at least three* must certify their recommendation from *personal* knowledge.

No. 2.

Letter notifying the Election of a Member.

Sir,

I have the honour to inform you that, on the day of you were elected a

Fellow of the Chemical Society. I herewith transmit you a copy of the Bye-laws, &c.

According to the Regulations of the Society, you are required to return the accompanying Obligation, duly signed, to the Secretary, and to pay the Admission Fee of £4, and the Annual Contribution for the current year, £2, before admission.*

Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in.*

I have the honour to remain,

Your obedient Servant,

____________________ *Secretary.*

No. 3.

Annual Circular Letter of the Treasurer.

January 1, 19

Sir,

I have the honour to inform you that your Annual Contribution of £______ to the Chemical Society for the year ______, is due this day.

Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in.

I have the honour to be,

Your obedient Servant,

____________________ *Treasurer.*

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* In the case of Honorary Members, Foreign Members, and Associates, this paragraph will be omitted.

No. 4.

Annual Circular Letter of the Treasurer to Fellows who are two years in arrear of their Subscriptions.

January 1, 19

Sir,

I have to inform you that your Subscription of £2 to the Chemical Society for the current year is now due, and that you are also in arrear of your subscription for the preceding year.

I have to inform you that if your arrears, amounting to £4, are not paid on or before the ——— of March next ensuing, you will, in accordance with the IVth Bye-law, cease to be a Fellow of the Society, and your name will be struck off from the list.

Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in.

I am, Sir,

Your obedient Servant,

Treasurer.

[*Issued by authority of the Council.*]

No. 5.

Balloting List for the Election of President and Officers.

CHEMICAL SOCIETY.

March, 19

BALLOTING LIST

FOR THE ELECTION OF OFFICERS.

Present Officers.	*Officers Proposed.*	
PRESIDENT.		
VICE-PRESIDENTS.		
SECRETARIES.		
FOREIGN SECRETARY.		
TREASURER.		

If you wish to substitute any other name, in place of that proposed, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute.

[*Issued by authority of the Council.*]

No. 6.

Balloting List for the Election of Ordinary Members of Council.

CHEMICAL SOCIETY.

March, 19

BALLOTING LIST

FOR THE ELECTION OF ORDINARY MEMBERS OF COUNCIL.

Present Members.	*Names of Fellows Proposed.*	

If you wish to substitute any other name, in place of that proposed, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute.

Richard Clay and Sons, Limited,
BREAD ST. HILL, E.C., AND
BUNGAY, SUFFOLK.

PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XX. Nos. 274—287.
JANUARY—DECEMBER, 1904.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1905.

Richard Clay and Sons, Limited,
BREAD STREET HILL, E.C., AND
BUNGAY, SUFFOLK.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to R. D. Abell, to investigate the products from condensation of ethylphenylketone with benzaldehyde.

£10 to J. B. Cohen, to investigate the chlorination and bromination of the aromatic hydrocarbons. Oxidation of the substituted toluenes.

£5 to J. B. Cohen, to continue the investigation on the chlorination and bromination of the aromatic hydrocarbons. Oxidation of the substituted toluenes.

£10 to A. W. Crossley, to investigate the action of phosphorus haloids on substituted dihydroresorcins, and the preparation of hydroaromatic hydrocarbons from the resulting derivatives.

£10 to H. D. Dakin, for the investigation of certain aromatic bases allied to adrenaline.

£10 to F. E. Francis, to investigate the action of nitrogen sulphide on organic substances.

£15 to A. Lapworth, for the investigation of some properties of $\alpha\beta$-unsaturated ketones, acids, and allied compounds.

£10 to H. R. Le Sueur, to investigate the action of heat on α-hydroxy-acids.

£10 to T. M. Lowry, for further studies of dynamic isomerism.

£25 to A. McKenzie, to investigate the studies in asymmetric synthesis.

£10 to J. W. Mellor, for the investigation of the constitution of silicates.

£20 to H. A. Miers, for the investigation of the regular growth of crystals of one substance upon those of another.

£10 to R. S. Morrell and E. K. Hanson, to investigate the oxidation of α- and β-crotonic acids.

£10 to R. H. Pickard, to investigate the optically active carbimides.

£5 to F. G. Pope, condensation of aromatic hydroxy-acids of the type of *o*-hydroxymandelic acid with resorcinol.

£5 to C. Smith, to investigate the derivatives of tetrahydronaphthalene with regard to their naphthalenoid and benzenoid characteristics.

£10 to J. J. Sudborough, for the continuation of the investigation on "Steric Hindrance" and on polynitro-compounds.

£10 to J. J. Sudborough, for the continuation of the investigation on "Steric Hindrance" and on polynitro-compounds.

£10 to G. Tattersall, to investigate the preparation of *trans*-glutaconic acid. Synthesis of inactive sylvestrene, of isocaprolactone, and their derivatives.

£10 to J. F. Thorpe, for the investigation on the formation of derivatives of trioxypyridine from ethyl α-cyano-β-imino-glutarate and its alkyl derivatives.

£5 to W. E. S. Turner, for the investigation of the effect of alcohol on the rate of saponification of esters.

LIST OF FELLOWS ELECTED DURING 1904.

Name.	Proposed.	Elected.
Ackroyd, John Prest	January 20th, 1904	February 17th.
Allen, William Harold Richard	June 15th, 1904	December 1st.
Baguley, Allan	November 18th, 1903.	February 17th.
Barbour, William	February 17th, 1904.	May 5th.
Bellars, Albert Ernest	April 20th, 1904	June 15th.
Benn, R. H. Durward	February 17th, 1904.	May 5th.
Bennett, Charles Thomas	January 20th, 1904	February 17th.
Benson, Alick Cole	December 16th, 1903.	,, ,,
Bentley, Walter Henry	November 3rd, 1904	December 1st.
Black, John Wyclif	,, ,, ,,	,, ,,
Brand, Herbert Frank	April 20th, 1904	June 15th.
Bridgett, Robert Currie	February 4th, 1904	May 5th.
Broderick, George Edward Peach	January 20th, 1904	February 17th.
Busher, Thomas Story	November 3rd, 1904.	December 1st.
Caldecott, Lawrence	November 3rd, 1904.	December 1st.
Caldwell, Robert John	,, ,, ,,	,, ,,
Clark, Peter Skinner	,, ,, ,,	,, ,,
Clayton, Ellis	February 17th, 1904.	May 5th.
Cooper, Jabez Horace	June 15th, 1904	December 1st.
Cowper, Alfred Denys	December 3rd, 1903.	February 17th.
Crabb, William	November 3rd, 1904.	December 1st.
Cunningham, James Edward	,, ,, ,,	,, ,,
Dalton, William Herbert	June 2nd, 1904	December 1st.
Deane, Harold	November 3rd, 1904.	,, ,,
Dickinson, Francis	,, ,, ,,	,, ,,
Drugman, Julien	January 20th, 1904	February 17th.
Evans, Edward	November 3rd, 1904.	December 1st.
Evans, John	June 2nd, 1904	,, ,,
Evans, Nevil Norton	December 3rd, 1903.	February 17th.
Fagan, Thomas Wallace	November 3rd, 1904.	December 1st.
Field, W. Eddington	May 5th, 1904	June 15th.
Finlow, Robert Steel	March 3rd, 1904	May 5th.
Forrest, James Rocheid	November 18th, 1903.	February 17th.
Forrest, John Kerr	November 3rd, 1904.	December 1st.
Fry, George	January 20th, 1904	February 17th.
Gawler, Robert	December 16th, 1903.	February 17th.
Gerard, Thomas Alfred	April 20th, 1904	June 15th.
Ghose, Ann	January 20th, 1904	February 17th.
Gilchrist, James Gray	April 20th, 1904	June 15th.
Glover, Harry James	November 18th, 1903.	February 17th.
Goodson, John Augustus	,, ,, ,,	,, ,,
Guthrie, John Monteath	December 3rd, 1903.	,, ,,

Name.	Proposed.	Elected.
Guttmann, Leo Frank	December 16th, 1903.	February 17th
Hammond, Harold Sankey	March 16th, 1904	May 5th.
Harold, Frederick Clarkson-	November 3rd, 1904.	December 1st.
Henzell, Archie Willoughby	June 2nd, 1904	,, ,,
Hodgson, Thomas Reginald	November 3rd, 1904.	,, ,,
Hoit, Alfred Henry	November 18th, 1903.	February 17th.
Horn, George Mathieson	March 3rd, 1904	May 5th.
Horrod, George William Thomas	November 3rd, 1904.	December 1st.
Hulme, John	May 5th, 1904	June 15th.
Inglis, John Kenneth Harold	November 3rd, 1904.	December 1st.
James, Thomas Campbell	November 3rd, 1904.	December 1st.
James, Walter Richmond	,, ,, ,,	,, ,,
Jenkins, Herbert	May 18th, 1904	June 15th.
Johnson, John Richard	November 3rd, 1904.	December 1st.
Johnston, John Haslam	April 20th, 1904	June 15th.
Jones, Horace Francis	November 3rd, 1904.	December 1st.
Jones, William App	,, ,, ,,	,, ,,
Joseph, Alfred Francis	,, ,, ,,	,, ,,
Komppa, Gustav	November 16th, 1904.	December 1st.
Lauder, James Stanley	November 3rd, 1904.	December 1st.
Le May, Percy Kent	February 17th, 1904.	May 5th.
Lessing, Rudolf, Ph.D	May 18th, 1904	June 15th.
Levy, Arthur Garfield	November 3rd, 1904.	December 1st.
Longstaff, James Patrick	,, ,, ,,	,, ,,
Lowe, Frank Harold	May 18th, 1904	June 15th.
McCourt, Cyril Douglas	December 16th, 1903.	February 17th.
McDougall, Arthur Thomas	November 3rd, 1904.	December 1st.
Mander, Alfred	March 3rd, 1904	May 5th.
Mathews, Harold Joseph Clarke	November 3rd, 1904.	December 1st.
Mears, Francis D'Oyley, Jun.	January 20th, 1904	February 17th.
Middleditch, Bernard	November 18th, 1903.	,, ,,
Millar, Ernest Westby	November 3rd, 1904.	December 1st.
Montgomery, Jack Percival	January 20th, 1904.	February 17th.
Moore, Tom Sidney	February 4th, 1904	May 5th.
Murray, Benjamin L.	December 16th, 1903.	February 17th.
Oakden, William Edward	May 18th, 1904	June 15th.
Oldfield, Laurel Cecil Francis	March 16th, 1904	May 5th.
Page, William Davidge	March 16th, 1904	May 5th.
Patterson, Thomas Stewart	December 16th, 1903.	February 17th.
Pell, Alfred	April 20th, 1904	June 15th.
Phillips, George Frederick	June 15th, 1904	December 1st.
Pinchbeck, Gerald	March 3rd, 1904	May 5th.
Pinkerton, David John	April 20th, 1904	June 15th.
Porter, Thos. Linton Daniel	March 16th, 1904	May 5th.
Prentice, Bertram	November 18th, 1903.	February 17th.
Riley, Louis John Ezekiel	March 16th, 1904	May 5th.
Robertson, Franklin Ernest	February 17th, 1904.	,, ,,
Rodger, Robert	May 18th, 1904	June 15th.

Name.	Proposed.	Elected.
Rouillard, Marie Jean Louis Ernest	November 3rd, 1904. .	December 1st.
Sanders, Percy Richard	April 20th, 1904	June 15th.
Sawer, Charles John..............	May 18th, 1904	,, ,,
Sen, Jatindranâth............................	January 20th, 1904...	February 17th.
Shacklady, Thomas George.................	February 17th, 1904..	May 5th.
Shelton, Henry Stanley	May 18th, 1904	June 15th.
Shrubsole, Alfred	December 16th, 1903.	February 17th.
Siau, Raymond Louis	January 20th, 1904...	,, ,,
Smith, Clarence	February 4th, 1904...	May 5th.
Smith, Gerald Oscar Morgan	,, ,, ,,	,, ,,
Smith, Henry Heron	March 16th, 1904.....	,, ,,
Smith, Samuel John	December 16th, 1903.	February 17th.
Spielmann, Percy Edwin.....................	November 3rd, 1904. .	December 1st.
Stanger, Reginald Harry Hursthouse ...	February 4th, 1904...	May 5th.
Stanley, Harry	November 3rd, 1904. .	December 1st.
Stevenson, Henry Ernest	January 20th, 1904...	February 17th.
Streatfeild, Frederick Henry	November 18th, 1903.	,, ,,
Struthers, Robert de Jersey Fleming- ...	March 3rd, 1904	May 5th.
Sutcliffe, Thomas	November 3rd, 1904. .	December 1st.
Thibault, Paul John	November 3rd, 1904..	December 1st.
Thompson, Charles Herbert	January 20th, 1904...	February 17th.
Thompson, Hubert	,, ,, ,,	,, ,,
Tingle, Alfred	December 16th, 1903.	,, ,,
Tong, Walter	March 3rd, 1904	May 5th.
Tonkin, Arnold Bertram..	June 2nd, 1904	December 1st.
Twiss, Douglas Frank	November 3rd, 1904..	,, ,,
Underhill, William Wood	November 18th, 1903.	February 17th.
Walling, Léon Edward	January 20th, 1904...	February 17th.
Watson, Edwin Roy............................	June 15th, 1904	December 1st.
Watson, Herbert Wood	November 3rd, 1904..	,, ,,
Watt, Francis Langston	November 18th, 1903.	February 17th.
Weeks, Henry Bridges........................	June 2nd, 1904	December 1st.
Weinberg, John	February 4th, 1904	June 15th.
Whiteley, Charles Edward	January 20th, 1904...	February 17th.
Wilkinson, James Alfred.....................	April 20th, 1904	June 15th.
Willcox, William Henry..	November 3rd, 1904. .	December 1st.
Woodcock, William Henry.................	January 20th, 1904...	February 17th.
Wyeth, Frank John............................	November 3rd, 1904. .	December 1st.
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Becquerel, Antoine Henri	May 5th, 1904....... .	May 18th.
Lobry de Bruyn, Cornelis Adriaan.........	,, ,, ,,	,, ,,
Clarke, Frank Wigglesworth	,, ,, ,,	,, ,,
Curie, (Madame) Marie	,, ,, ,,	,, ,,
Liebermann, Carl Theodor	,, ,, ,,	,, ,,
Morley, Edward Williams	,, ,, ,,	,, ,,

FELLOWS DECEASED, 1904.

Name.	Elected.	Died.
Allen, Alfred Henry	February 18th, 1864	July 14th, 1904.
Allhusen, F. E.	May 3rd, 1894	October 17th, 1904.
Barclay, John	March 4th, 1897	July 19th, 1903.
Bell, Sir Isaac Lowthian	December 3rd, 1863	December 20th, 1904.
Benger, Frederick Baden	November 19th, 1874	January 28th, 1903.
Beringer, Cornelius	June 21st, 1883	August 28th, 1903.
Bilimoria, Hormasji Naoroji	December 6th, 1900	August 5th, 1904.
Chattaway, William	December 5th, 1895	October 7th, 1904.
Dey, Preo Lall	March 4th, 1886	August 11th, 1904.
Dodd, Thomas Henry	December 2nd, 1875	January 22nd, 1904.
Dodd, William Henry	April 19th, 1888	June 24th, 1899.
Doran, Robert Elliott	May 20th, 1886	October 13th, 1904.
Francis, William	November 7th, 1842	January 19th, 1904.
Gibson, Adam	March 5th, 1885	August 19th, 1904.
Grenfell, Claude G.	March 1st, 1883	January 26th, 1901.
Grimshaw, Harry	February 19th, 1874	January 29th, 1904.
Howsam, George	April 22nd, 1903	July 25th, 1904.
Isherwood, Thomas	February 16th, 1882	January 13th, 1904.
Jackson, John	December 15th, 1892	January 23rd, 1904.
Kitchin, Archibald	June 19th, 1873	March 5th, 1904.
*Lobry de Bruyn, Cornelis Adriaan	May 18th, 1904	July 23rd, 1904.
*Markownikoff, Wladimir Wasiljevič	January 20th, 1898	February 11th, 1904.
Mason, James	November 4th, 1858	April 2nd, 1903.
Munro, Donald	December 7th, 1871	August 13th, 1904.
Pooley, Thomas Alexander	March 6th, 1862	December 8th, 1904.
St. John, Harry	April 21st, 1898	February 14th, 1904.
Sawer, Charles John	June 15th, 1904	August 23rd, 1904.
Stanger, W. Harry	March 17th, 1887	February 13th, 1903.
Swan, Robert McNair Wilson	June 20th, 1889	March 25th, 1904.
Williamson, Alexander William	May 15th, 1848	May 6th, 1904.

* Honorary and Foreign Member.

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2. The chemical reactions of nickel carbonyl. Part II. Reaction with aromatic hydrocarbons in presence of aluminium chloride. Synthesis of aldehydes and anthracene derivatives. By James Dewar and Humphrey Owen Jones	6	212
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14. Organic derivatives of silicon. Preparation of alkylsilicon chlorides. By Frederic Stanley Kipping	15	—

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18. Action of nitrogen peroxide on 1-nitrocamphene. By Martin Onslow Forster and Frances Mary Gore Micklethwait	19	325
19. The tautomeric character of the acyl thiocyanates. A preliminary note. By Robert Elliott Doran	20	—
20. Resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents. By Robert Selby Morrell and Edward Kenneth Hanson	20	197
21. Aromatic compounds obtained from the hydroaromatic series. Part I. The action of bromine on 3 : 5-dichloro-1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene. By Arthur William Crossley	21	264
22. The action of nitrogen sulphide on organic substances. Part I. By Francis Ernest Francis and Oliver Charles Minty Davis	21	259
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75. A study of the substitution products of *ar*-tetrahydro-α-naphthylamine. 4-Bromo-*ar*-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid. By Gilbert Thomas Morgan, Frances Mary Gore Micklethwait, and Herbert Ben Winfield.	109	736
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102. Gynocardin, a new cyanogenetic glucoside. Preliminary note. By Frederick Belding Power and Frank Howorth Gornall	137	—
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106. The union of hydrogen and chlorine. Action of the silent discharge on chlorine. By Joseph William Mellor	140	—
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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 274.

Wednesday, January 20th, 1904. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. U. O. S. Nairne and J. T. Hall were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

J. P. Ackroyd, B.Sc., 116, Richmond Street, Accrington, Lancs.
Charles Thomas Bennett, 57, Larkhall Rise, Clapham, S.W.
George E. P. Broderick, B.Sc., Lampeter, S. Wales.
Julian Drugman, Ph.D., La Bocca, Cannes, France.
George Fry, Carlin Brae, Berwick-on-Tweed.
Francis D'Oyley Mears, jun., 4, Nyanza Terrace, Swansea.
Jatindranâth Sen, M.A., 71, Cathedral Mission Lane, Calcutta.
Raymond Louis Siau, 15, Merridale Lane, Wolverhampton.
Henry E. Stevenson, Avondale, Ditton Hill, Surrey.
Charles H. Thompson, Hillcroft, Amblecote, Stourbridge.

Hubert Thompson, B.Sc., Holmes Chapel, Cheshire.
Léon Edward Walling, 43, Union Road, Rotherhithe.
Charles Edward Whiteley, 9, Abyssinia Grove, Leeds.
William Henry Woodcock, 10, Chesson Road, W. Kensington, W.

Certificates in favour of the following were authorised by the Council for presentation for Ballot under Bye-Law I (3):

Anu Ghose, 42, Shambazar Street, Calcutta.
J. P. Montgomery, Agricultural College, Starkville, Miss., U.S.A.

The PRESIDENT announced that since the last meeting of the Society the Rev. T. J. Prout, M.A., F.G.S., Senior Student of Christ Church, Oxford, had presented to the Society a photograph of a portrait by Hayes of his father, Dr. William Prout, F.R.S., which was considered to be a very good likeness of the author of the famous paper "On the Relation between the Specific Gravities of Bodies in their Gaseous State and the Weights of their Atoms," published anonymously in Thomson's *Annals of Philosophy* in November, 1815.

The Council has ordered the following report to be printed in the Journal and in the Proceedings of the Society:

Report of the International Committee on Atomic Weights.

The International Committee on Atomic Weights * has the honour to offer the following report:

In the table of atomic weights for 1904, only two changes from 1903 are recommended. The atomic weight of cæsium has been slightly modified to accord with the recent determinations by Richards and Archibald, and that of cerium in conformity with the measurements by Brauner. The value for lanthanum is still in controversy, and any change here would therefore be premature. The same consideration may also be urged with regard to iodine. Ladenburg has shown that the accepted number for iodine is probably too low, but other investigations upon the subject are known to be in progress, and until they have been completed it would be unwise to propose any alteration.

Many of the atomic weights given in the table are well known to be more or less uncertain. This is especially true with respect to the rarer elements, such as gallium, indium, columbium, tantalum, &c. But some of the commoner elements also stand in need of revision, and we venture to call attention to a few of these. Among the metals, the atomic weights of mercury, tin, bismuth, and antimony should be redetermined, for the reason that the existing data are not sufficiently concordant. Palladium also, on account of discrepancies between different observers, and possibly vanadium, for which the data are too few, deserve some attention. Among the non-metals, phosphorus has been peculiarly neglected, and our knowledge of the atomic weight of silicon rests upon a single ratio. In the latter case, confirmatory data are much to be desired. Upon any of these elements, new investigations would be most serviceable.

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* The original members of the Committee take great pleasure in announcing the addition to their number of Professor Henri Moissan. They are confident that this increase will meet with universal approval.

There is one other point to which we may properly call attention. Many of the ratios from which atomic weights have been calculated were measured in vessels of glass, by processes involving the use of strong acids. In such cases, the solubility of the glass becomes an important consideration, even when no transfer of material from one vessel to another has occurred. A slight conversion of silicate into chloride would cause an increase of weight during the operation, and so introduce an error into the determination. Such errors are doubtless very small, but still they ought not to be neglected. Now that vessels of pure silica, the so-called quartz-glass, are available for use, they might well replace ordinary glass in all processes for the determination of atomic weights. An investigation into the relative availability of the two kinds of glass is most desirable.

F. W. CLARKE
T. E. THORPE
K. SEUBERT
HENRI MOISSAN
} *Committee.*

1904.

International Atomic Weights.

		O=16.	H=1.			O=16.	H=1.
Aluminium	Al	27·1	26·9	Neodymium	Nd	143·6	142·5
Antimony	Sb	120·2	119·3	Neon	Ne	20	19·9
Argon	A	39·9	39·6	Nickel	Ni	58·7	58·3
Arsenic	As	75·0	74·4	Nitrogen	N	14·04	13·93
Barium	Ba	137·4	136·4	Osmium	Os	191	189·6
Bismuth	Bi	208·5	206·9	Oxygen	O	16·00	15·88
Boron	B	11	10·9	Palladium	Pd	106·5	105·7
Bromine	Br	79·96	79·36	Phosphorus	P	31·0	30·77
Cadmium	Cd	112·4	111·6	Platinum	Pt	194·8	193·3
Cæsium	Cs	132·9	131·9	Potassium	K	39·15	38·86
Calcium	Ca	40·1	39·8	Praseodymium	Pr	140·5	139·4
Carbon	C	12·00	11·91	Radium	Rd	225	223·3
Cerium	Ce	140·25	139·2	Rhodium	Rh	103·0	102·2
Chlorine	Cl	35·45	35·18	Rubidium	Rb	85·4	84·8
Chromium	Cr	52·1	51·7	Ruthenium	Ru	101·7	100·9
Cobalt	Co	59·0	58·56	Samarium	Sm	150	148·9
Columbium	Cb	94	93·3	Scandium	Sc	44·1	43·8
Copper	Cu	63·6	63·1	Selenium	Se	79·2	78·6
Erbium	Er	166	164·8	Silicon	Si	28·4	28·2
Fluorine	F	19	18·9	Silver	Ag	107·93	107·12
Gadolinium	Gd	156	155	Sodium	Na	23·05	22·88
Gallium	Ga	70	69·5	Strontium	Sr	87·6	86·94
Germanium	Ge	72·5	71·9	Sulphur	S	32·06	31·83
Glucinum	Gl	9·1	9·03	Tantalum	Ta	183	181·6
Gold	Au	197·2	195·7	Tellurium	Te	127·6	126·6
Helium	He	4	4	Terbium	Tb	160	158·8
Hydrogen	H	1·008	1·000	Thallium	Tl	204·1	202·6
Indium	In	114	113·1	Thorium	Th	232·5	230·8
Iodine	I	126·85	125·90	Thulium	Tm	171	169·7
Iridium	Ir	193·0	191·5	Tin	Sn	119·0	118·1
Iron	Fe	55·9	55·5	Titanium	Ti	48·1	47·7
Krypton	Kr	81·8	81·2	Tungsten	W	184	182·6
Lanthanum	La	138·9	137·9	Uranium	U	238·5	236·7
Lead	Pb	206·9	205·35	Vanadium	V	51·2	50·8
Lithium	Li	7·03	6·98	Xenon	Xe	128	127
Magnesium	Mg	24·36	24·18	Ytterbium	Yb	173·0	171·7
Manganese	Mn	55·0	54·6	Yttrium	Yt	89·0	88·3
Mercury	Hg	200·0	198·5	Zinc	Zn	65·4	64·9
Molybdenum	Mo	96·0	95·3	Zirconium	Zr	90·6	89·9

Of the following papers, those marked * were read :

*1. "The chemical reactions of nickel carbonyl. Part I. Reactions with the halogens and other inorganic substances." By James Dewar and Humphrey Owen Jones.

The previous study of the physical properties of nickel carbonyl (*Proc. Roy. Soc.*, 1903, 71, 627) showed that it was a comparatively stable substance when heated under pressure. The authors have undertaken the investigation of its chemical behaviour mainly from a thermochemical standpoint, with the view of studying its constitution and its possible use as a synthetical agent.

Nickel carbonyl is completely decomposed by solutions of chlorine, bromine, iodine, cyanogen, and sulphur in organic solvents, carbon monoxide and a nickel compound being produced ; in no case was any combination of the carbon monoxide with the halogen or other reagent observed, even when a considerable excess of the latter was present.

From Mittasch's value (52·2 Cal.) for the heat of formation of nickel carbonyl and Thomsen's values for nickel compounds, it was to be expected that chlorine and bromine would decompose it readily, but that iodine, cyanogen, and sulphur would not. In the case of iodine, the heat necessary to carry out the reaction appears to be obtained by the formation of molecular complexes of nickel iodide and the solvent (for example, ether and chloroform), and in the case of sulphur by the formation of a higher sulphide, probably Ni_2S_3. Liquid chlorine and bromine decompose solid nickel carbonyl, but solid iodine appears to have no action on liquid nickel carbonyl.

Iodine mono- and tri-chlorides and cyanogen iodide in carbon tetrachloride solution react with nickel carbonyl in two distinct stages, the free iodine liberated at first subsequently decomposing a further quantity of nickel carbonyl.

Hydrogen iodide readily interacts with nickel carbonyl, whereas the corresponding bromide and chloride do not affect it.

Hydrogen sulphide reacts very slowly with nickel carbonyl, producing nickel monosulphide, hydrogen, and carbon monoxide. Sulphuric acid also decomposes the compound slowly, giving rise to nickel sulphate, hydrogen, and carbon monoxide.

*2. "The chemical reactions of nickel carbonyl. Part II. Reaction with aromatic hydrocarbons in presence of aluminium chloride. Synthesis of aldehydes and anthracene derivatives." By James Dewar and Humphrey Owen Jones.

Nickel carbonyl does not react with either aluminium chloride or benzene separately, but with a mixture of the two substances, a violent reaction begins immediately and torrents of hydrochloric acid are evolved. The reaction with various benzene homologues has been investigated both at the ordinary temperature and also at 100°.

From benzene at the ordinary temperature, benzaldehyde is produced together with traces of oils having high boiling points. At 100°, the quantity of benzaldehyde is much smaller, and anthracene, which is now the chief product, is produced in considerable quantities. The mechanism of this production of anthracene from benzaldehyde has not been elucidated, but the reduction is probably due to the action of the nickel produced by the decomposition of the nickel carbonyl.

Toluene gives *p*-tolualdehyde and 2 : 6-dimethylanthracene (m. p. 215—216°). *m*-Xylene similarly yields 2 : 4-dimethylbenzaldehyde and a tetramethylanthracene melting at 280°, which is in all probability 1 : 3 : 5 : 7-tetramethylanthracene. Mesitylene yields an aldehyde only, condensation to an anthracene derivative being in this case impossible.

Naphthalene behaves in an entirely different way; no aldehyde is formed either in the cold or at 100°, and a hydrocarbon, $C_{16}H_{12}$, is produced together with oily or resinous substances having very high boiling points, which appear to be further condensation products, since the quantity produced is much greater at the higher temperature. This hydrocarbon, which melts at 180—181°, is probably identical with that obtained by Bischoff by the interaction of naphthalene and methyl chloride in the presence of aluminium chloride, and may also be identical with that produced from ruficoccine or coccinine by distillation with zinc dust.

*3. "Optically active asymmetric nitrogen compounds. *d*- and *l*-Phenylbenzylmethylethylammonium salts." By Humphrey Owen Jones.

The resolution of the phenylbenzylmethylethylammonium salts was undertaken with the view of showing that optical activity in nitrogen compounds was independent of the existence of isomerides of the compound in question.

The only optically active nitrogen compounds known at present are the *d*- and *l*-α-phenylbenzylmethylallylammonium salts, and these are also the only quinquevalent nitrogen compounds (not containing an asymmetric carbon atom) which have been shown to exist in definite stable isomeric forms.

Phenylbenzylmethylethylammonium iodide has been prepared in the three possible ways, namely, by the following combinations: (1) methylethylaniline and benzyl iodide, (2) benzylethylaniline and methyl iodide, (3) benzylmethylaniline and ethyl iodide. The velocity of formation of the iodide is remarkably different in the three cases, that in the first combination being the greatest and that in the third being the least. The compound produced, which is the same in all three cases, crystallises from alcohol in lustrous, prismatic prisms, the melting point of which is about 140—142°, but this is to a certain extent dependent on the rate of heating.

The iodide was converted into the *d*- and *l*-camphorsulphonates by boiling molecular proportions of the salt and silver *d*- and *l*-camphorsulphonates with ethyl acetate and a small quantity of alcohol.

The camphorsulphonate was crystallised repeatedly from a mixture of dry ethyl acetate and ethylal at a comparatively low temperature until its rotatory power was constant. *d*-Phenylbenzylmethylethylammonium *d*-camphorsulphonate crystallises in lustrous prisms melting at 180—181°. It is very sparingly soluble in ethyl acetate and acetone and has $[M]_D = 71 \cdot 0°$ in aqueous solution.

The corresponding *ll*-salt is identical with its *dd*-isomeride in appearance and properties and has $[M]_D = -71 \cdot 2°$. *d*-Phenylbenzylmethylethylammonium iodide, which was obtained by mixing the calculated quantities of potassium iodide and the *d*-camphorsulphonate in aqueous solution, has the same appearance, crystalline form, and melting point as the inactive iodide; it is very sparingly soluble in alcohol and other solvents. Its rotatory power is small, so that determinations of this constant are difficult, the observed $[M]_D$ being about 30°. The corresponding *l*-iodide, which was prepared from the *l*-camphorsulphonate in a similar manner, had $[M]_D = 30°$ (approximately). The iodides undergo racemisation in chloroform solution, but their molecular weight in this solvent appears to be nearly normal at the ordinary temperature.

The inactive and lævorotatory bromides were also prepared and were found to melt at 155—156°. The latter compound has a higher specific rotatory power than the *l*-iodide.

The feeble rotatory power of these salts compared with that of the active α-phenylbenzylmethylallylammonium salts is remarkable, since the only difference is the replacement of an allyl by an ethyl radicle.

*4. "A microscopic method of determining molecular weights." By George Barger.

The author has continued the experiments of which a preliminary account has already been given (Proc., 1903, 19, 121). The method is based on the comparison of the vapour pressures of two solutions, of which biconcave, lenticular drops are placed in a capillary tube. A difference in the vapour pressures causes a mutual variation in the size of the drops, which is observed by means of an eye-piece micrometer.

About one hundred determinations with various substances in eleven different solvents have now been made, and the experimental error is found to vary from 5 to 10 per cent. Solvents of widely differing boiling points have been employed, including ether, xylene, and light petroleum (b. p. 50—60°). Some determinations were performed with minute quantities of the dissolved substance.

The method is being applied to the study of association in mixtures of associative and non-associative solvents. The behaviour of benzoic acid in mixtures of benzene and ethyl alcohol, and of cinnamic acid in mixtures of chloroform and methyl alcohol has so far been studied, the results showing that a small proportion of the alcohol suffices to give these acids a normal molecular weight. Should this phenomenon prove to be general, it would be of practical value in determining molecular weights in those cases where associative solvents only can be employed.

Discussion.

Dr. Philip asked whether it would be possible to carry out the experiments at a higher temperature, nearer the boiling point of the solvent, in order to shorten the time necessary for the establishment of equilibrium between the drops.

Dr. Hewitt suggested the possibility of using two graduated tubes fitted with tightly-fitting india-rubber stoppers and connected by a T-tube, the third branch of which should have a stop-cock. Into one of the graduated tubes a standard solution could be introduced, and into the other a weighed quantity of the substance, together with some of the solvent. It would then only be necessary to exhaust the apparatus, place it in a bath until equilibrium was attained, allow to cool, and measure the respective volumes of solution in the two graduated tubes.

Mr. Barger, in reply to Dr. Philip, said that the tubes must either be measured at the higher temperature or cooled down to that of the microscope. In the latter case, the solvent condenses between the drops on the walls of the tube, and thus produces an error. In the former case, it has not been found possible to prevent the condensation of water vapour on the frontal lens of the microscope objective.

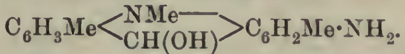
Macroscopic methods similar to that suggested by Dr. Hewitt have been tried, both volumetrically and gravimetrically, but without the least success. The essential conditions which make the present method possible are:

(1) The accuracy with which extremely small changes in volume of the drops can be detected under the microscope.

(2) The large evaporating surface presented by the drops, as compared with their volume.

*5. “Studies in the acridine series. Part I.” By John Jacob Fox and John Theodore Hewitt.

The authors find that 6-acetamino-2 : 7-dimethylacridine (m. p. 270° uncorr., Ullmann gives 258°, *Ber.*, 1903, **36**, 1025) unites with methyl iodide to form a quaternary acridinium iodide, a substance yielding a precipitate with ammonia. The isolation of the corresponding carbinol seems impracticable on account of the ease with which the acetyl group is hydrolysed. To ensure complete hydrolysis, the solution obtained on boiling the precipitate with dilute sulphuric acid is treated with ammonia, when the base is liberated. This compound, which, when crystallised from acetone, has a pale red colour, melts at 210° (uncorr.) and corresponds with the formula $C_{16}H_{18}ON_2$; it is probably a carbinol having the following constitution:



$$C_6H_3Me<\begin{array}{c}NMe—\\CH(OH)\end{array}>C_6H_2Me\cdot NH_2.$$

When the carbinol base is heated for some hours at 184°, partial dehydration occurs, and on warming the nitrobenzene solution of the substance, a very appreciable evolution of water is observed. On filtering the hot solution and subsequently treating the cooled filtrate with light petroleum, a dark red compound, $C_{16}H_{14}N_2$, is deposited, which is readily soluble in acids and probably has the constitution $C_6H_3Me<\begin{array}{c}NMe\\—CH\end{array}\geqslant C_6H_2Me{:}NH$, because the oxygen removed as water was attached in the carbinol base to the carbon atom of the median ring. Such a formula for the anhydro-base agrees with the constitution $C_6H_4<\begin{array}{c}NPh\\—N\end{array}\geqslant C_6H_3{:}NH$, for the base of aposafranine, and does not correspond with the aposafranine formula suggested by Kehrmann (compare *Ber.*, 1896, **29**, 2316; *Annalen*, 1896, **290**, 256).

6. "*o*-Nitrobenzoylacetic acid." By Edward Rushton Needham and William Henry Perkin, jun.

Ethyl sodioacetoacetate (2 mols.) reacts readily with *o*-nitrobenzoyl chloride (1 mol.), yielding the sodium compound of ethyl *o*-nitrobenzoylacetoacetate, $NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CAcNa{\cdot}CO_2Et$ (Gevekoth, *Annalen*, 1883, **221**, 323), and when this product is digested with ammonia and ammonium chloride (compare Claisen, *Annalen*, 1896, **291**, 67) the acetyl group is eliminated and *ethyl* o-*nitrobenzoylacetate*,

$$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CH_2{\cdot}CO_2Et,$$

is produced. This ester is a pale brown oil which, in alcoholic solution, gives an orange-red coloration with ferric chloride; it readily dissolves in dilute aqueous caustic potash yielding a yellow, crystalline *potassium* derivative, $NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CHK{\cdot}CO_2Et$, and when its ethereal solution is shaken with ammoniacal copper sulphate, the green, crystalline *copper* derivative, $NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CH{\cdot}Cu_{\frac{1}{2}}{\cdot}CO_2Et$, is obtained. Ethyl *o*-nitrobenzoylacetate dissolves in concentrated sulphuric acid, and if the solution is heated at 90° for a few minutes and then poured into water, o-*nitrobenzoylacetic acid*,

$$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CH_2{\cdot}CO_2H,$$

separates, and may be purified by crystallisation from water. It melts at about 118°, and, when boiled with water, is decomposed into *o*-nitroacetophenone and carbon dioxide.

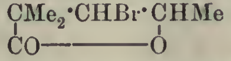
7. "The *cis*- and *trans*-modifications of ααγ-trimethylglutaconic acid." By William Henry Perkin, jun., and Alice Emily Smith.

The authors have already shown (Trans., 1903, **83**, 772) that when ethyl ααγ-trimethylacetonedicarboxylate,

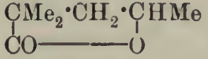
$$CO_2Et{\cdot}CMe_2{\cdot}CO{\cdot}CHMe{\cdot}CO_2Et,$$

is reduced with sodium amalgam, it is converted into a mixture of the *cis*- and *trans*-modifications of β-hydroxy-ααγ-trimethylglutaric acid, $CO_2H{\cdot}CMe_2{\cdot}CH(OH){\cdot}CHMe{\cdot}CO_2H$, and both of these, by treatment first with phosphorus pentachloride and then with diethylaniline, yield *trans*-ααγ-trimethylglutaconic acid, $CO_2H{\cdot}CMe_2{\cdot}CH{:}CMe{\cdot}CO_2H$, which melts at 150°. They now show that on distillation both of the foregoing hydroxy-acids are converted into the anhydride of the *cis*-modification of *ααγ-trimethylglutaconic acid*, which melts at 88°, and on hydrolysis yields the corresponding acid melting at about 125°. On treatment with bromine, *cis*-trimethylglutaconic acid yields cis-*βγ-dibromo-ααγ-trimethylglutaric acid*, $CO_2H{\cdot}CMe_2{\cdot}CHBr{\cdot}CMeBr{\cdot}CO_2H$, which melts at 168°.

During the distillation of the hydroxy-acids, a considerable amount of carbon dioxide and steam is eliminated, and an oily acid is produced which distils at 213°. This substance, *crotonyldimethylacetic acid*, $CO_2H{\cdot}CMe_2{\cdot}CH{:}CHMe$, when treated with bromine, yields the lactone of β-bromo-γ-hydroxy-ααγ-trimethylbutyric acid (m. p. 83°),



$$\begin{array}{l}CMe_2{\cdot}CHBr{\cdot}CHMe\\ CO\text{————————}O\end{array},$$

and, when boiled with dilute sulphuric acid, is converted into the lactone of γ-hydroxy-ααγ-trimethylbutyric acid (α-dimethylvalerolactone),  $\begin{array}{l}CMe_2{\cdot}CH_2{\cdot}CHMe\\ CO\text{—————}O\end{array}$, which melts at 52° and has already been described by Anschütz and Gillet (*Annalen*, 1888, **247**, 107), who obtained it by the reduction of αα-dimethyllævulic acid,

$$CO_2H{\cdot}CMe_2{\cdot}CH_2{\cdot}COMe.$$

8. "The influence of substitution in the nucleus on the rate of oxidation of the side-chain. I. Oxidation of the mono- and dichlorotoluenes." By Julius Berend Cohen and James Miller.

The method of oxidation adopted was to heat about a gram of each of the isomerides with dilute nitric acid in a sealed tube for a length of time insufficient for complete oxidation and to estimate the proportion of the acid product and the unchanged substance. The vessel employed as air-bath was a jacketed, tin-plate cylinder containing boiling coal-tar naphtha and furnished with a condenser, the tubes being heated in the inner compartment, which was kept at a nearly constant temperature.

The results of several series of experiments show that the monohalogen derivatives are more rapidly attacked than the dihalogen compounds. Of the three monochlorotoluenes, the meta-compound is least rapidly and the para-isomeride most rapidly oxidised. Of the dihalogen compounds, the 3 : 5-compound is least affected; then follow the 2 : 5- and 2 : 6-isomerides, which are oxidised about equally; then the 2 : 3-compound, and finally the 2 : 4- and 3 : 4-compounds, which may be bracketed together as being most readily attacked.

So far as these experiments are concerned, in which the oxidising agent is nitric acid, the results are perfectly definite. The meta-compounds retard and the para-derivatives assist oxidation, whilst the ortho-compounds occupy an intermediate position.

Thus, *m*-chlorotoluene and 3 : 5-dichlorotoluene are least attacked by the acid, whereas *p*-chlorotoluene and the 2 : 4- and 3 : 4-dichlorotoluenes, which each contain a chlorine atom in the para-position with respect to the methyl group, are most rapidly oxidised.

9. "The interdependence of the physical and chemical criteria in the analysis of butter fat." By Thomas Edward Thorpe.

In the course of an investigation on the chemical nature of butter produced within the British Isles, which was instituted by the Board of Agriculture for the information of a Departmental Committee appointed to report as to what regulations might with advantage be made for determining what deficiency in any of the normal constituents of butter should raise a presumption under the Food and Drugs Acts that the butter was not genuine, it became necessary to obtain at first-hand the values of butter of known origin and produced from milk given under varying conditions. Observation has shown that the chemical nature of butter fat is dependent, to a certain extent, on the climatic influences to which the cows are exposed, on the nature and amount of the food supplied, and on the breed, period of lactation, and idiosyncrasy of the individual cow. In order to give such weight as was practicable to the effect of these factors, the samples of butter were obtained from carefully selected districts, and often from cows set apart for the purpose of the inquiry, whilst particulars of the breed, diet, stabling, and period of lactation were supplied with the samples in nearly all cases. For example, to illustrate the effects of more rigorous climatic conditions than obtain in the United Kingdom generally, farms and dairies in Caithness, Sutherland, the Orkneys, Shetlands, and the Hebrides were laid under contribution, whilst a series of samples from Hollesley Bay, Suffolk, served to exemplify the effect on the cattle of exposure to the winds of the North Sea.

Of the 430 samples received, 357 were examined as regards their Reichert-Wollny number, their relative density, saponification value, and refractometric value, and in a certain number of typical cases their Hübl value was ascertained.

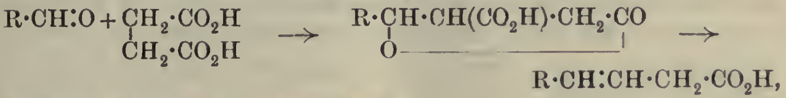
The main results of these observations have been tabulated and compared and their interdependence exhibited by means of curves.

10. "A simple thermostat for use in connection with the refractometric examination of oils and fats." By Thomas Edward Thorpe.

The thermostat is primarily intended for use in connection with the Zeiss butyro-refractometer, in which a current of water, usually at about 45^c or a little warmer, is caused to circulate round the prism casing. This arrangement is somewhat more convenient than that usually employed, occupies less space, and is sooner brought into action. It has for some years past been employed in the Government Laboratory in the examination of butter.

11. "The condensation of furfuraldehyde with sodium succinate." By Arthur Walsh Titherley and James Frederick Spencer.

Fittig has shown (*Annalen*, 1883, **216**, 97; 1889, **255**, 1—142) that aldehydes condense with sodium succinate in the presence of acetic anhydride, giving substituted paraconic and *iso*crotonic acids:



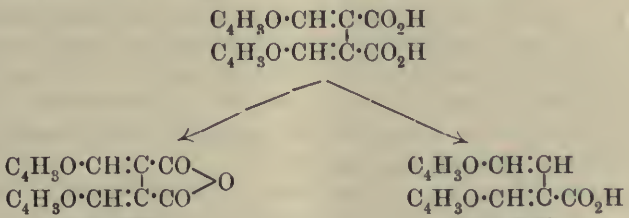
$$R\cdot CH{:}O + \begin{array}{l} CH_2\cdot CO_2H \\ CH_2\cdot CO_2H \end{array} \longrightarrow \begin{array}{l} R\cdot CH\cdot CH(CO_2H)\cdot CH_2\cdot CO \\ O\text{———————————}\big| \end{array} \longrightarrow R\cdot CH{:}CH\cdot CH_2\cdot CO_2H,$$

where R is any alkyl or aryl radicle.

The authors in attempting to employ this method for the synthesis of β-furfurylidenepropionic (furfuryl*iso*crotonic) acid by condensing furfuraldehyde with sodium succinate in presence of acetic anhydride found that neither it nor furfurylparaconic acid is formed, but two unexpected derivatives were produced, which were isolated with considerable difficulty, the yields being very small.

One of these substances, which crystallised in dark orange-coloured needles melting at 187°, was found to be *difurfurylidenesuccinic anhydride*, $C_{14}H_8O_5$, and the other, which separated in bright yellow plates (m. p. 213°), was identified as *$\alpha\gamma$-difurfurylidenepropionic acid*, $C_{13}H_{10}O_4$. These results indicated that two furfuraldehyde molecules condensed with one molecule of sodium succinate, and all attempts to prepare the corresponding monofurfurylidene derivatives failed.

These products may be regarded as being produced from the difurfurylidene derivative in the following manner:



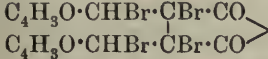
$$\begin{array}{c} C_4H_3O\cdot CH{:}C\cdot CO_2H \\ C_4H_3O\cdot CH{:}C\cdot CO_2H \end{array}$$

$$\begin{array}{l} C_4H_3O\cdot CH{:}C\cdot CO \\ C_4H_3O\cdot CH{:}C\cdot CO \end{array}\!\!>O \qquad\qquad \begin{array}{l} C_4H_3O\cdot CH{:}CH \\ C_4H_3O\cdot CH{:}C\cdot CO_2H \end{array}$$

m. p. 187°. m. p. 213°.

The orange-coloured anhydride is decomposed with difficulty by sodium hydroxide, forming sodium *difurfurylidenesuccinate*; the acid is a yellow, crystalline powder melting at 185—187° and regenerating the anhydride. The acid is also converted into the anhydride on gently warming with acetyl chloride.

The anhydride readily combines with bromine, yielding the well-defined tetrabromide, *$\alpha\alpha\beta\beta$-tetrabromo*-s-*difurfurylsuccinic anhydride*,



$\begin{array}{l} C_4H_3O\cdot CHBr\cdot CBr\cdot CO \\ C_4H_3O\cdot CHBr\cdot CBr\cdot CO \end{array}\!\!>O$, a bright yellow powder melting at 196° and giving fluorescent solutions.

The yellow $\alpha\gamma$-difurfurylidenepropionic acid (m. p. 213°) was obtained as the sole crystallisable product and in larger yield, on using succinic anhydride as the dehydrating agent instead of acetic anhydride, but in all cases the condensation of furfuraldehyde with sodium succinate was accompanied by the formation of large quantities of resinous matter.

12. "The action of heat on α-hydroxycarboxylic acids. A preliminary note." By Henry Rondel Le Sueur.

The *aldehyde*, $C_{16}H_{33}\cdot CHO$, which is produced by heating α-hydroxystearic acid, crystallises from light petroleum in needles melting at 36°, and from alcohol in needles containing 1 mol. of the solvent and melting at 52°; it forms a crystalline *compound* with sodium hydrogen sulphite, and the *oxime* and *semicarbazone* melt at 89·5° and 107—108° respectively.

The *acid*, $C_{16}H_{33}\cdot CO_2H$, obtained by oxidising the aldehyde with potassium permanganate, crystallises from light petroleum in long needles melting at 60—61°; the *silver* salt, $C_{17}H_{33}O_2Ag$, is amorphous.

The author is investigating the action of heat on other mono- and di-basic α-hydroxy-acids.

13. "The fusion of *iso*pilocarpine with caustic potash. A correction." By Hooper Albert Dickinson Jowett.

In a communication on the constitution of pilocarpine (*Trans.*, 1900, 77, 860), the author showed that an acid, then regarded as *iso*butyric acid, was produced by the fusion of *iso*pilocarpine with caustic potash. The existence of the *n*-butyl group in *iso*pilocarpine, as proved by the formation of α-ethyltricarballylic acid from homopilopic acid, and the production of *n*-butyric acid by fusion of pilopic acid with caustic potash, however, rendered it probable that the acid previously described as *iso*butyric acid was really *n*-butyric acid. The experiment has therefore been repeated.

Ten grams of *iso*pilocarpine were fused with 100 grams of caustic potash, and the fatty acid separated in the manner previously described (*loc. cit.*). The portion distilling between 120° and 160° was collected and converted into the calcium salt by neutralisation with calcium carbonate. The acid was not soluble in a small amount of water, but dissolved almost completely in a larger quantity. The calcium salt, which separated from the hot aqueous solution on concentration, was collected while hot; it formed white, pearly plates, which were dried in the air and analysed:

0·1982 lost 0·0162 H_2O at 150°. $H_2O = 8{\cdot}2$.
0·1780 ,, 0·0144 H_2O ,, 100°. $H_2O = 8{\cdot}1$.
$(C_4H_7O_2)_2Ca,H_2O$ requires $H_2O = 7{\cdot}8$ per cent.

Calcium *iso*butyrate crystallises with 4 molecules of water.

On warming an aqueous solution of the salt, saturated at 0°, crystals separated, which redissolved on cooling.

The silver salt was prepared and recrystallised from water.

0·1312 gave 0·0726 Ag. Ag = 55·3.
$C_4H_7O_2Ag$ requires Ag = 55·4 per cent.

The volatile acid formed by the fusion of *iso*pilocarpine with caustic potash is therefore *n*-butyric acid.

14. "Organic derivatives of silicon. Preparation of alkylsilicon chlorides." By Frederic Stanley Kipping.

It has been previously shown that tetra-alkyl derivatives of silicon can be obtained by treating silicon tetrachloride with alkyl halides in presence of sodium (Kipping and Lloyd, Trans., 1901, **79**, 449). The investigation of silicon compounds has recently been resumed in conjunction with Mr. A. Hunter, and attempts have been made to prepare compounds of the type $SiR_1R_2R_3Cl$ with the following results.

Silicon tetrachloride interacts vigorously with an ethereal solution of magnesium ethyl iodide, the product consisting of a mixture of ethylsilicon trichloride, diethylsilicon dichloride, triethylsilicon chloride, and silicon tetraethyl, the proportions of which depend on the relative quantity of the magnesium compound employed.

Silicon tetrachloride also interacts very vigorously with an ethereal solution of magnesium ethyl bromide; when molecular proportions of the two compounds are used, the product contains a small quantity of the di- and tri-ethyl derivatives, but consists principally of ethyl silicon trichloride, which can be isolated by fractional distillation and has the properties assigned to it by Ladenburg.

Ethylsilicon trichloride and an ethereal solution of magnesium phenyl bromide interact very readily, and *phenylethylsilicon dichloride* can be isolated by fractional distillation; this compound is a fuming liquid boiling at about 228—230° and readily decomposed by water, giving an oil which appears to be the *silicoketone*, SiEtPhO.

Phenylethylsilicon dichloride and an ethereal solution of magnesium propyl bromide do not give an immediate precipitation of magnesium salt, but on warming, a reaction occurs with the formation of *phenylethylpropylsilicon chloride*, which is obtained after fractional distillation, mixed apparently with unchanged dichloride, as a colourless liquid boiling indefinitely at about 240°.

These and other alkyl derivatives of silicon tetrachloride are now being examined, and, in conjunction with Dr. Caven, analogous experiments have been commenced with the object of preparing mixed alkyl derivatives of phosphorus, more especially compounds of the type $POR_1R_2R_3$ or $POR_1R_2{\cdot}OH$.

15. "Derivatives of highly substituted anilines." By Frederick Daniel Chattaway and John Mello Wadmore.

The authors described the preparation and properties of a series of highly substituted acyl- and chloro-amines obtained in the course of an investigation into the phenomena of intramolecular rearrangement in aromatic amines.

ERRATUM.

(Proc., 1903, 19, No. 273.)

Page 282, line 9 from bottom, *for* "trialkylhydroxylamines" *read* "trialkyloxamines."

At the next Meeting, on **Thursday**, February 4th, at **8** p.m., the following Papers will be communicated:

"The tautomeric character of the acidic thiocyanates. A preliminary note." By R. E. Doran.

"The resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents." By R. S. Morrell and E. K. Hanson.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 13/2/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 275.

Thursday, February 4th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. F. G. Smith, H. F. Knight, G. J. Alderton, A. J. Carrier, and F. B. Gatehouse were formally admitted Fellows of the Society.

The PRESIDENT announced that the Council had resolved that a congratulatory address should be sent to Prof. Mendeléeff on the occasion of his 70th birthday on Tuesday next, February 9th, a date which would also be that of his official retirement, although he would actually remain at his post for another year.

Certificates were read for the first time in favour of Messrs.

Robert Bridgett, M.A., B.Sc., 32, Queen Anne Street, Dunfermline.
Tom Sidney Moore, B.A., B.Sc., 99, Rann Street, Birmingham.
Clarence Smith, D.Sc., Denmark Lodge, Hatcham, S.E.
Gerald Oscar Morgan-Smith, The Studio, Trowse, Norwich.
Reginald Harry H. Stanger, 33, Ladbroke Grove, W.
John Weinberg, Rosa, United Provinces, India.

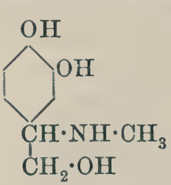
Of the following papers, those marked * were read:

*16. "The constitution of epinephrine." By Hooper Albert Dickinson Jowett.

"Epinephrin" was the name given by Abel and Crawford to the active principle of the suprarenal glands, and the substance is identical, when pure, with the "adrenalin" of Takamine and the "suprarenin" of von Fürth. As Abel and Crawford were the first to isolate the active principle, although in an impure condition, the author has adopted the name proposed by them. Analysis and molecular weight determinations of carefully purified material confirmed the formula $C_9H_{13}O_3N$, first produced by Aldrich. In dilute acetic acid solution, the compound has $[\alpha]_D -32{\cdot}6°$.

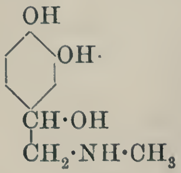
On oxidation with potassium permanganate, methylamine and oxalic and formic acids were formed. By fusion with potassium hydroxide, a small amount of a crystalline substance was obtained which gave the protocatechuic acid reaction with ferric chloride. On methylation with methyl iodide and sodium in methyl alcohol and subsequent oxidation with potassium permanganate, trimethylamine and veratric acid were obtained.

The bearing of these results on the constitution of the base was discussed, the following alternative formulæ being put forward:



I.

or



II.

,

the second of which was considered the more probable.

*17. "Studies on the electrolytic oxidation of phenols. Part I." By Arthur George Perkin and Frederick Mollwo Perkin.

When pyrogallol was oxidised in neutral or slightly acid solutions, purpurogallin was precipitated in a very pure condition as an orange-red powder, the best results being obtained with an electrolyte of 15 per cent. sodium sulphate. The iridio-platinum anode, which was rotated during the electrolysis, and the leaden cathodes were not separated by means of a porous cell. With a current density of 2 amperes per square decimetre, the *E.M.F.* was 4·3—4·5 volts (compare *Proc.* 1903, 19, 58).

When gallic acid was oxidised with an electrolyte of sodium acetate and acetic acid, a black or brown powder was obtained, which was found to be purpurogallincarboxylic acid. In this case, the current conditions were practically the same as in the preceding experiment, but the anode and cathode were separated by means of a porous cell. The purpurogallincarboxylic acid thus obtained is not pure, and the yield is very variable.

*18. "Action of nitrogen peroxide on 1-nitrocamphene." By Martin Onslow Forster and Frances Mary Gore Micklethwait.

When a current of nitrogen peroxide is passed into a chloroform solution of 1-nitrocamphene (*Trans.*, 1901, 79, 644), the temperature rises, crystals separate, and the filtrate becomes bluish-green. The *nitrosate*, $C_{10}H_{15}O_6N_3$, thus produced to the extent of 24 per cent., is very sparingly soluble in organic media and melts at 217°, when it decomposes; it is probably bimolecular.

The *compound*, $C_{10}H_{14}O_4N_2$, obtained by the limited action of alcoholic ammonia, piperidine, or potassium hydroxide on the foregoing substance, is insoluble in dilute acids and alkalis; it crystallises from alcohol in transparent prisms melting at 123°, and has $[\alpha]_D - 159·0°$.

By the continued action of alcoholic alkali, a green oil is produced which may also be extracted from the bluish-green chloroform mother liquor of the nitrosate; the substance forms a brown solution in alkali hydroxides, and has not been analysed because it decomposes spontaneously when isolated.

The *compound*, $C_{10}H_{14}O_5N_2$, formed on oxidising with potassium ferricyanide the green oil dissolved in potassium hydroxide, crystallises from light petroleum in snow-white needles melting at 85—86°. It dissolves in sodium carbonate and develops a red coloration with ferric chloride; the *silver*, *copper*, and *ammonium* derivatives have been analysed. The *bromo*-derivative, $C_{10}H_{13}O_5N_2Br$, precipitated when potassium hypobromite acts on solutions in alkali hydroxides, crystallises from alcohol in colourless needles melting at 157°, and has $[\alpha]_D - 68°$. Alcoholic potash regenerates the substance $C_{10}H_{14}O_5N_2$.

The *compound*, $C_{10}H_{11}O_5N_2Br_3$, produced by the action of potassium hypobromite on the green oil dissolved in potassium hydroxide, crystallises from light petroleum in pale brown prisms melting at 78°; it has $[\alpha]_D + 4·2°$.

Methylaminocamphene, $C_{10}H_{15}·NHMe$, was prepared by treating with methyl iodide the benzylidene derivative of the primary base, and hydrolysing the product with moist ethyl acetate ; it boils at 202— under 756 mm. pressure, has sp. gr. 0·9171 at 22°, and $[\alpha]_D$ + 28·7° in absolute alcohol. The *platinichloride* melts and decomposes at 214°.

19. "The tautomeric character of the acyl thiocyanates. A preliminary note." By Robert Elliott Doran.

In the course of the present investigation (compare Dixon, *Trans.*, 1901, **79**, 543), it has been established that the tendency for acetyl thiocyanate either to react as such or to behave as a thiocarbimide depends almost entirely on the temperature, although the tautomeric change is also influenced to some extent by the nature of the base with which the compound is caused to interact.

Thus, when aniline is employed, it is possible to bring about the changes indicated by either of the following equations:

I. $CH_3CO{\cdot}SCN + 2PhNH_2 = PhNH{\cdot}CO{\cdot}CH_3 + PhNH_2,HSCN$;

II. $CH_3{\cdot}CO{\cdot}NCS + PhNH_2 = CS(NHPh){\cdot}NH{\cdot}CO{\cdot}CH_3$;

the first reaction takes place at the ordinary temperature, and the second on warming.

By means of the latter reaction, several new acetylated thioureas have been prepared, together with others (for example, acetylthiourea), which, although previously described, have not hitherto been obtained directly from the parent substance. The yields obtained with various bases and at different temperatures have also been studied.

20. "Resolution of $\alpha\beta$-dihydroxybutyric acid into its optically active constituents." By Robert Selby Morrell and Edward Kenneth Hanson.

Of a series of salts of the active bases with $\alpha\beta$-dihydroxybutyric acid, derived from α-crotonic acid, the quinidine salt is the only one which admits of resolution into its two active components, so that these can be separated by crystallisation from water. The quinidine *l*-salt is very sparingly soluble in this solvent, and from it the *l*-$\alpha\beta$-dihydroxybutyric acid has been prepared. The free acid has the same melting point as the racemic substance, but it crystallises in six-sided plates and not in needles. Its specific rotation is −13·5°, this being numerically greater than that of *d*-glyceric acid, which has $[\alpha]_D$ + 2·14° (Frankland and Frew, *Trans.*, 1891, **59**, 96), and smaller than that of *l*-β-hydroxybutyric acid ($[\alpha]_D - 24·8°$) (Mackenzie, *Trans.*, 1903, **81**, 1402). The barium salts of the *d*- and *l*-acids have been prepared, and the specific rotation of the barium *l*-salt is greater than that of the free acid. Faber and Tollens (*Ber.*, 1899, **32**, 2598) have described salts of a dihydroxybutyric acid, obtained, together with *iso*saccharic acid, by the action of lime water on oxycellulose. The rotation of this αβ-dihydroxybutyric acid is given as + 13·7°, and it is probable that this acid is the *d*-isomeride, corresponding with the *l*-modification obtained from α-crotonic acid.

21. "Aromatic compounds obtained from the hydroaromatic series. Part I. The action of bromine on 3 : 5 dichloro-1 : 1-dimethyl-$\Delta^{2:4}$-dihydrobenzene." By Arthur William Crossley.

Dichlorodimethyldihydrobenzene, on treatment with two molecular proportions of bromine, yields *dichlorotribromodimethyltetrahydrobenzene*, $C_8H_9Cl_2Br_3$, crystallising in stout, prismatic needles and melting at 118°. When heated to a few degrees above its melting point, this substance rapidly evolves two molecular proportions of hydrogen bromide, giving rise to 3 : 5-*dichloro*-4-*bromo*-o-*xylene*, which crystallises in felted needles melting at 100°. The constitution of this aromatic compound has been definitely decided by synthesis.

If, however, dichlorodimethyldihydrobenzene is treated with only one molecular proportion of bromine, an unstable liquid results, which, on heating, loses hydrogen bromide, giving as the main products 3 : 5-dichloro-*o*-xylene and 3 : 5-*dichloro*-6-*bromo*-o-*xylene* (m. p. 42°).

On further bromination, both these dichlorobromoxylenes give 3 : 5-*dichloro*-4 : 6-*dibromo*-o-*xylene*, crystallising from ethyl acetate in glistening needles (m. p. 233°), but they differ markedly in their behaviour towards nitric acid.

Thus, 3 : 5-dichloro-4-bromo-*o*-xylene, on treatment with fuming nitric acid, gives 3 : 5-*dichloro*-4-*bromo*-6-*nitro*-o-*xylene*, and yields 3 : 5-*dichloro*-4-*bromo*-o-*phthalic acid* when oxidised with dilute nitric acid under pressure, whereas under similar conditions, 3 : 5-dichloro-6-bromo-*o*-xylene furnishes respectively 3 : 5-*dichloro*-4 : 6-*dinitro*-o-*xylene* and 3 : 5-*dichloro*-6-*nitro*-o-*toluic acid*.

22. "The action of nitrogen sulphide on organic substances. Part I." By Francis Ernest Francis and Oliver Charles Minty Davis.

Nitrogen sulphide reacts readily with aromatic aldehydes. Benzaldehyde gives triphenylcyanidin (cyaphenin) and a small quantity of lophin, probably formed by the reduction of the former compound by the sulphur dioxide liberated in the reaction. *p*-Tolualdehyde reacts similarly, giving the corresponding tritolylcyanidin. Anisaldehyde, however, yields only very small quantities of *p*-trimethoxyphenylcyanidin, the main product of the reaction being a white, insoluble powder, which is at present under investigation.

23. "Dibenzoylchloroimide." By Frederick Daniel Chattaway.

The author points out that Stieglitz and Earle have overlooked his paper (*Proc.*, 1902, **18**, 165; *Chem. Centr.*, 1902, II, 359), communicated to the Society on June 18th, 1902, which contains a description of the preparation and properties of the diacylchloroimides, including the dibenzoylchloroimide again described by these investigators (*Amer. Chem. J.*, 1903, **30**, 420). Stieglitz and Earle state that, owing to the ease with which the diacylchloroimides are hydrolysed, it is necessary to exclude water entirely in the preparation of these substances. This, however, is contrary to the author's experience, for the chloroimides are readily obtained in the presence of water in the manner indicated in the former paper (*Proc.*, *ibid.*).

Dibenzoylchloroimide, when pure, melts at 89°, or three degrees higher than the temperature given by Stieglitz and Earle.

The diacylchloroimides are readily hydrolysed, yielding the diacylimides and hypochlorous acid either when left in contact with water or when heated with this medium, but the reaction is reversible.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Clowes, Frank, and Coleman, J. Bernard. Elementary practical chemistry. Part II. Analytical chemistry. 4th ed. pp. xvi + 212. ill. London 1903. From the Authors.

Dibdin, W. J. The purification of sewage and water. 3rd ed. pp. xxxv + 379. ill. London 1903. From the Author.

Dyer, Bernard. Fertilisers and feeding stuffs. Their properties and uses. With the full text of the Fertilisers and Feeding Stuffs Act, 1893, the regulations and forms of the Board of Agriculture, and notes on the Act by A. J. David. 4th ed. pp. 124. London 1903. From the Author.

Muter, John. A short manual of analytical chemistry, qualitative

and quantitative—inorganic and organic. Following the course of instruction given in the laboratories of the South London School of Pharmacy. 9th ed. pp. xiv + 235. ill. London 1903.
From the Author.

New South Wales. Department of Mines and Agriculture. Memoirs of the Geological Survey. Geology, No. 3. The kerosene shale deposits of N.S.W.; with maps, plates, and sections. By J. E. Carne. Sydney 1903. From the Department.

Royal Commission on Arsenical Poisoning. Reports of the Royal Commission appointed to enquire into arsenical poisoning from the consumption of beer and other articles of food and drink. 4 vols. London 1901—1903. From the Commission.

II. *By Purchase.*

Ahrens, Felix B. Handbuch der Elektrochemie. 2 Auflage. pp. x + 686. ill. Stuttgart 1903.

Benedikt, Rudolf. Analyse der Fette und Wachsarten. Vierte, erweiterte Auflage, bearbeitet von Ferdinand Ulzer. pp. xii + 941. ill. Berlin 1903.

Delbrück, M., und Schönfeld, F. System der natürlichen Hefereinzucht. Gesammelte Vorträge und Arbeiten. pp. viii + 148. Berlin 1903.

Lunge, George. A theoretical and practical treatise on the manufacture of sulphuric acid and alkali, with the collateral branches. Vol. I. Sulphuric Acid. pp. xxvii + 1214. ill. 2 vols. London 1903.

At the next Meeting, on **Wednesday**, February 17th, at **5.30** p.m. there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Observations on some continuous intramolecular and at first reversible changes extended over prolonged periods of time." By R. J. Friswell.

"The esterification of *r*-mandelic acid by menthol and borneol." By A. McKenzie.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 17th, 1904.

Ackroyd, John Prest,

116, Richmond Street, Accrington, Lancashire.

Master of Chemical Department, Municipal Technical School, Accrington. Student in Chemical Department, Yorkshire College, Leeds, 1897—1900. B.Sc. (London). Chemistry taken in Final Examination, 1900. Teacher of Chemistry, 1902 and 1903, in Technical Schools, viz., Waverley Road Higher Grade, Birmingham, and Technical School, Accrington. Desirous of keeping in touch with recent work through the Chemical Society.

Arthur Smithells. H. M. Dawson.
J. B. Cohen. Fredk. Doyle.
W. T. Leeming.

Baguley, Allan,

University College of North Wales, Bangor.

Assistant Lecturer in Agricultural Chemistry. Bachelor of Science (with Second Class Honours in Chemistry), University of Wales. Associate of the Institute of Chemistry.

Kennedy J. P. Orton. Harry Baker.
Alexander Lauder. James J. Dobbie.
James Robson.

Bennett, Charles Thomas,
57, Larkhall Rise, Clapham, S.W.

Analytical chemist in laboratory of Messrs. Wright, Layman, and Umney, Ltd., Southwark, S.E., during the last five years. Pharmaceutical Chemist. Honours in Chemistry at Intermediate B.Sc. (Lond.), 1901. Working for B.Sc. (Honours in Chemistry) at South-Western Polytechnic under Prof. Coleman. Papers on Copaiba, Olive Oil, and Chinese Neroli Oil, in conjunction with J. C. Umney, Esq., and on Adulterated Citronella and Peppermint Oils in conjunction with E. J. Parry, Esq., B.Sc.

Chas. Umney.
John C. Umney.
Ernest J. Parry.
Thos. Tyrer.
J. B. Coleman.
Peter MacEwan.

Benson, Alick Cole,
33, Perham Road, W. Kensington.

Analytical Chemist. Studied two years at St. George's Hospital, passed exams. in Chemistry and Biology for M.R.C.S., L.R.C.P. Two years as pupil, afterwards as assistant, in the laboratory of Mr. Matthew J. Cannon. At present engaged as Chemist to the Granular Yeast Co., Clapton.

Matthew J. Cannon.
Leonard Temple Thorne.
Matthew Cannon.
Edgar Foll.
Alfred C. Chapman.

Broderick, George Edward Peach,
"Bryn Llewelyn," Lampeter, S. Wales.

Science Master at St. David's College School, Lampeter. Bachelor of Science, London University. Five and a half years in the laboratory of Messrs. Blackwell, Hayes and Co., Manufacturing Chemists, Moor Street, Birmingham. Now engaged in teaching, and wishing to have the advantages of the Society to be able to keep in touch with present work in Chemistry.

T. Goode Joyce.
T. Slater Price.
Robert H. Pickard.
Keith B. Benham.
Percy F. Frankland.

Cowper, Alfred Denys,
3, Bishop's Mansions, Fulham, S.W.

Student. One year in Chemical Laboratory, University College, London, as student. Intermediate Science Exam. London Univ., September, 1902, First Class Pass.

William Ramsay.	C. E. Kenneth Mees.
J. Norman Collie.	Morris W. Travers.
N. T. M. Wilsmore.	John R. Tustin.

Drugman, Julien,

La Bocca, Cannes, France.

Research Student at Owens College, Manchester. I obtained the Ph.D. degree (Bonn) with a dissertation on "Acid-esters of some Dibasic Acids." Worked later under Professor Ramsay ("On the Specific Gravity of the Halogens at their Boiling Points"). Then was Assistant Lecturer at Reading College for two years. Am now doing research work at Owens College.

Harold B. Dixon.	W. H. Perkin, jun.
William Ramsay.	William A. Bone.

D. L. Chapman.

Evans, Nevil Norton,

Montreal, Canada.

Assistant Professor of Chemistry, McGill University. Since graduation from McGill University in 1886, has, with the exception of two years spent in Germany with Winkler at Freiberg and Ostwald in Leipzig, been engaged in teaching at McGill, as demonstrator, lecturer, and Assistant Professor.

B. J. Harrington.	A. Stansfield.
J. Wallace Walker.	Jeffrey H. Burland.

G. P. Girdwood.

Forrest, James Rocheid,

Kirkee, near Poona, India.

Major, Royal Army Medical Corps. "The proteids of red marrow," in *Journal of Physiology*, 1894 (?). "The antiseptic action of certain inorganic salts" (with Prof. Howlett of King's Coll., not yet published); D.P.H. Camb.; late Sanitary Officer, Oudh District, and Off'g Sanitary Officer, Bengal Command.

John E. Mackenzie.	Lewis Eynon.
H. F. C. Goltz.	*Holland Crompton.*

F. Southerden.

Fry, George,

Carlin Brae, Berwick-on-Tweed.

A timber merchant, who has devoted his leisure hours to the study of chemistry since 1867. Up to 1889 was constantly engaged in the production of cellulose from wood, and the chemical questions connected therewith. He has undertaken the investigation of several biological, physiological, and chemical problems, the results of one of which he published in 1885 under the title of the "Theory of sweet ensilage." He is still engaged in research connected with the growth of trees and plants; desires to keep himself informed of the advance in organic chemistry bearing on the subjects in which he is interested. Fellow of the Linnean Society.

J. Augustus Voelcker. C. F. Cross.
Edward Bevan. *Bernard Dyer.*
E. W. Voelcker.

Gawler, Robert,

3, South View Terrace, Bennett Road, Headingley, Leeds.

Assistant Science Master at the Technical School, Dewsbury. For four years a student at the Yorkshire College. Graduated B.Sc. (1900), Honours School of Chemistry (1901), M.Sc. (1903).

Arthur Smithells. Julius B. Cohen.
H. M. Dawson. Henry R. Procter.
H. J. Taylor.

Glover, Harry James,

33, Albert Road, Stroud Green, N.

Assistant Science-Master in the Stationers' Company's School, Hornsey, N. Internal Student of the University of London. "Honours" courses in Chemistry under Dr. Dunn and Dr. Mackenzie during past four years. Assistant-Master, Stationers' School, 1900—1903.

W. J. Stainer. Alex. W. Bain.
W. H. C. Jemmett. Alfred Greeves.
Albert E. Dunstan.

Goodson, John Augustus,

19, Darnley Road, Hackney, N.E.

Assistant Chemist to the Aylesbury Dairy Co. Certificated day-student of Finsbury Technical College. Matriculated Student of London University.

H. Droop Richmond. John Castell-Evans.
R. Meldola. Chas. R. Darling.
F. Southerden.

Guthrie, John Monteath,

199, Ferry Road, Leith, N.B.

Analytical Chemist. Studied Chemistry in Edinburgh School of

Medicine and in Heriot-Watt College, Edinburgh. Assistant to the City Analyst, Edinburgh, for over four years, being head assistant for over a year. Assistant Chemist to the Distillers' Co., Ltd., for two years, and Assistant Chemist to Wm. Younger and Co., Brewers, Edinburgh, for three years.

J. Falconer King. Hugh Marshall.
John E. Mackenzie. John S. Ford.
George Young.

Guttmann, Leo Frank,

18, Aberdare Gardens, London, N.W.

Research Chemist. Ph.D. Heidelberg. A.I.C., A.C.G.I. Author of "Percentage Tables for Elementary Analysis" (about to be published in three languages).

Oscar Guttmann. Gerald T. Moody.
William Ramsay. J. Lewkowitsch.
Henry E. Armstrong. Otto Hehner.

Hoit, Alfred Henry,

4, Montgomerie Road, Southsea.

Chemist. Pharmaceutical Chemist. A student of Mr. W. Watson-Will, F.C.S. Chemist and Manager to Messrs. Timothy White Company, Manufacturing Chemists and Wholesale Druggists, Portsmouth.

W. Watson-Will. Thos. H. Moore.
Thos. Tyrer. *Peter MacEwan.*
Frederick B. Power.

McCourt, Cyril Douglas,

52, Victoria Rd., Clapham, S.W.

Research Chemist to The Morgan Crucible Co., Ltd., Battersea, London. Obtained the diploma of Associate of the City and Guilds of London Institute at the termination of a three years' course of Chemistry at the Central Technical College, South Kensington.

Henry E. Armstrong. William A. Davis.
Gerald T. Moody. T. M. Lowry.
William Robertson.

Mears, Francis D'Oyley, jun,

4, Nyanza Terrace, Swansea.

Brewer's Chemist. Student at Swansea Technical College for three years. Previously privately and since in Brewery Laboratory. I desire to become a Fellow of the Chemical Society to further my knowledge by attending lectures and obtaining Journal.

Clarence A. Seyler. Stanley J. Peachey.
William J. Pope. W. A. Wayland.
Arthur R. Ling.

Middleditch, Bernard,
Woodcroft, Harrow-on-the-Hill.

Chemistry Master, Harrow School. B.A. of Jesus College, Cambridge.

John Talbot. M. M. Pattison Muir.
B. P. Lascelles. R. S. Morrell.
S. Ruhemann.

Murray, Benjamin L.,
19, University Place, New York City.

Chemist. Have taken following degrees at Univ. of Michigan at Ann Arbor, Ph.C., 1891; B.S. (Chem.), 1896; B.S. (Pharm.), 1897. Engaged as Chemist at State and National Agl. Exper. Station at Geneva, N.Y., 1891—1894. Seven years as chemist for Merck and o., American branch of E. Merck, of Darmstadt, Germany.

Albert B. Prescott. Marston Taylor Bogert.
Otis C. Johnson. C. F. Chandler.
Clifford Richardson.

Patterson, Thomas Stewart,
Lyddon Hall, Leeds.

Assistant Lecturer and Demonstrator in Chemistry at the Yorkshire College, Leeds. Lecturer in Chemistry in the Victoria University. Ph.D. (Heidelberg). Late Priestley Scholar at Mason College, Birmingham. Author or joint author of the following papers:—"Iodoso- and Iodoxy-benzaldehydes" (*Trans.*, 1898); "Mono-, Di-, and Trichloracetyl Methylic and Ethylic Glycerates and Tartrates" (*Trans.*, 1898); "Acetyl and Phenacetyl Derivatives of Diethyl Tartrate" (*Trans.*, 1900); "Preparation of Esters from other Esters of the same Acid" (*Trans.*, 1901); "Influence of Solvents on the Rotation of Optically Active Compounds, Part I" (*Trans.*, 1901); Part II (*Trans.*, 1901); Part III (*Trans.*, 1902); Part IV (*Trans.*, 1902); "Modified Forms of Thermo-Regulator and Adapter for Vacuum Distillation," *J.S.C.I.*, 1902.

Arthur Smithells. J. B. Cohen.
Percy F. Frankland. A. G. Green.
G. G. Henderson. A. G. Perkin.
T. L. Patterson. H. M. Dawson.
C. F. Baker.

Prentice, Bertram,

Royal Technical Institute, Salford.

Head of the Chemistry Department, Roy. Technical Inst., Salford. Graduated Ph.D. (Munich) in 1895, and D.Sc. (Edinburgh) in 1902. Published papers on "Some Derivatives of Dimethylacrylic Acid" (*Annalen*, **292**, 272), and on "Pulegone," in *Ber. der deutsch. Chem. Ges.*, **29**, 1078.

W. H. Perkin, jun. — Francis Jones.
G. H. Bailey. — George Young.
Jas. R. Appleyard.

Sen, Jatindranâth,

71, Cathedral Mission Lane, Calcutta, India.

Student of Chemistry. M.A. Calcutta (1899). Premchand Roychand Studentship (Research). Two papers:—"Uber die Zersetzung der Merkurammoniumsalze unter dem Einfluss der Wärme," *Zeit. anorg. Chem.*, Bd. **33**, (1902), S. 198. "Decomposition of Mercurous Nitrite by Heat," by Dr. P. C. Rây and Jatindranâth Sen, *Journ. Chem. Soc., Trans.*, Vol. **83**, (1903), P. 491.

William Tate. — H. E. Stapleton.
P. C. Rây. — Alex. Pedler.
Chuni lal Bose.

Shrubsole, Alfred,

91, Holyhead Road, Coventry.

Analytical Chemist. Major Qualification of Pharmaceutical Society of Great Britain. Student in Chemistry for 18 months at the Liverpool School of Pharmacy under the late J. S. Ward, Esq., F.C.S. Studied for 4 months at the Central School of Chemistry, London, under the late J. Woodland, Esq., F.C.S., F.L.S. Have worked specially in Coal and Fuel Analysis, Drugs and Commercial Chemicals; and for the last 18 months as Assistant Analyst, under H. W. Jones, Esq., F.C.S., in the laboratories of Messrs. Wyley's, Ltd., Coventry. Am anxious to receive current literature of the Society.

W. F. Wyley. — W. F. J. Shepheard.
H. W. Jones. — John Bairstow.
W. F. Lowe.

Siau, Raymond Louis,

15, Merridale Lane, Wolverhampton.

Chemist to a Brewing Company. Lond. matric. 1886. Student

R. C. Science, 1888—9. Assistant to F. W. Pavy, F.R.S., 1890—1903. Contributions with F. W. Pavy to the *Journal of Physiology.*

W. D. Halliburton.
Adrian J. Brown.
Arthur R. Ling.
Julian L. Baker.
M. O. Forster.
G. T. Morgan.

Smith, Samuel John,

41, Grafton Street, Dublin.

Pharmaceutical Chemist and Lecturer on Chemistry (private). I desire admission to the Society in order to follow the modern developments of chemistry.

Chas. R. C. Tichborne.
Jos. F. Burnett.
James S. Ashe.
Harold W. Harrie.
Thos. Tyrer.

Stevenson, Henry Ernest,

"Avondale," Ditton Hill, Surrey.

Manufacturing Chemist. Five years' private training prior to 1879. From 1880 to 1894 a partner in the firm of Fletcher, Fletcher and Stevenson, Manufacturing Chemists, Holloway, N. Subsequently principal of H. E. Stevenson and Co., now incorporated into that of Baiss Brothers and Stevenson, Limited (established prior to 1833), Manufacturing Chemists, Jewry Street, E.C., of which Company I am Managing Director.

David Howard.
D. Lloyd Howard.
Chas. Umney.
John C. Umney.
Wm. Chattaway.

Streatfeild, Frederick Henry,

9, Crescent Road, South Tottenham, N.

Senior Demonstrator and Assistant Lecturer at the West Ham Municipal Technical Institute. Certificated City and Guilds Technical College, Finsbury. Two years Research Assistant to Prof. R. Meldola, F.R.S. Co-author, with Prof. Meldola, of a paper on "Phenol Derivatives," published in the Journal of the Chemical Society. Six years Senior Demonstrator and Assistant Lecturer in Chemistry at the West Ham Municipal Technical Institute. Recognised Teacher of the London University.

Harold A. Auden.
R. Meldola.
F. Southerden.
Gerald T. Moody.
H. Harding.
William A. Davis.

Thompson, Charles Herbert,
Hillcroft, Amblecote, Stourbridge.

Chemist. After going through courses of Organic and Inorganic Chemistry and the usual Analytical Work, I have during the last ten years been engaged in Ceramic Chemistry and the study of the production of coloured glass with a view to produce compounds of any desired colour and coefficient of expansion, and I am at present engaged in this work. I have worked at this special branch of Chemistry in England and under Monsieur Oton. Isbecque, of Charleroi, and Floreffe in Belgium. Also under other continental Chemists, and particularly under the systems of M. Leon Appert and M. Jules Henrivaux, of Paris, France.

William Thomson.
William J. Pope.
Edgar Neuman.
J. Carter Bell.
C. Estcourt.
T. Fairley.

Thompson, Hubert,
Agricultural College, Holmes Chapel, Cheshire.

Lecturer in Chemistry and Analyst at the above. Lecturer in Chemistry during the past 12 months at the Cheshire Agricultural College ; 4 years as student at the Yorkshire College, obtaining the Degree of B.Sc. in 1902, Chemistry being one of the subjects of examination.

Arthur Smithells.
Julius B. Cohen.
W. Lowson.
H. M. Dawson.
C. E. Womersley.
A. Peacock.

Tingle, Alfred,
Imperial Provincial College of Shantung, Chinaufu, Shantung, China.

Professor of Chemistry. B.Sc. (Aberdeen and London), Ph.D. (Pennsylvania). Publications :—*Amer. Chem. Jour.*, 25, 144 ; 24, 276 ; 24, 45 ; 23, 214 ; 21, 238 (two latter in conjunction with J. B. Tingle) ; *J. Amer. Chem. Soc.*, 1899, 792 ; *Jour. Soc. Chem. Ind.* (in conjunction with W. Morrison), 22, 730 ; *Trans. Chem. Soc. Lond.* (in conjunction with F. R. Japp, F.R.S.), 1897, 1138.

J. Bishop Tingle.
F. R. Japp.
G. D. Lander.
W. Carleton Williams.
George Young.

Underhill, William Wood,
10, Hartham Road, Holloway, N.

Science Master, Higher Grade School, Seven Sisters Road, N., teaching Chemistry and Physics. Associate of the College of Preceptors. Queen's Prize for Practical Chemistry, 1896. Seven years engaged in teaching Chemistry. For 3 years a student under Dr. J. T. Hewitt. For the last 3 years in sole charge of a Chemical Laboratory. The use of the Society's Library and the Journal would be an invaluable assistance to me professionally.

Edgar E. Horwill. J. T. Hewitt.
A. J. Hyder. *James H. Gardiner.*
Chas. T. F. Watts.

Walling, Léon Edward,
43, Union Rd., Rotherhithe.

Certificated Teacher. Besides four years at Day and Evening Classes in Elementary Work, I have worked for two years as a student under W. T. Boone, Esq., at Cheltenham Training College, and a further two years under Dr. Lapworth at Goldsmiths' Institute, New Cross.

A. Lapworth. A. W. Harvey.
A. C. O. Hann. Will. T. Boone.
A. H. Coote.

Watt, Francis Langston,
111, Lauderdale Mns., Lauderdale Rd., Maida Vale, W.

Analytical Chemist. I am an Associate of the Royal College of Science (in Chemistry), and studied Chemistry also at Technical College, Sydney, New South Wales. I am now studying the analysis of Foods and Drugs in the laboratory of Mr. A. C. Chapman, F.I.C.

Alfred C. Chapman. James C. Philip.
Chapman Jones. F. Guy Stirling Baker.
Fredk. T. Harry.

Whiteley, Charles Edward,
9, Abyssinia Grove, Leeds.

Demonstrator of Chemistry. Student of the Yorkshire College, 1896—1902. Demonstrator in same Institution, 1902— . Published with Dr. Cohen under his guidance, "Experiments on the production of optically active compounds from inactive substances" in *J. C. S. Trans.*, 1901, Vol. 79. At present engaged in research work with Prof. Smithells.

Arthur Smithells. A. G. Perkin.
J. B. Cohen. H. M. Dawson.
W. Lowson. *A. B. Steven.*

Woodcock, William Henry,

10, Chesson Road, W. Kensington, W.

Analytical Chemist. For the last nine years have been assistant to Bertram Blount, Esq.

Bertram Blount. Patrick H. Kirkaldy.
Herbert Jackson. D. Northall Laurie.
R. Curling Styles.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I. (3):

Ghose, Anu,

42, Shambazar Street, Calcutta, India.

Analytical Chemist and Assayer to Messieurs Jambon & Cie., Manganese Mines, C.P., and Copper Mines, Bengal. Demonstrator of Chemistry for three years in St. Xavier's College, Calcutta. Sometime Assistant Chemist, Economic Laboratory, Indian Museum. Author of an investigation on *Asphodelus tenuifolius*, published as an "Agricultural Ledger" by the Government of India.

David Hooper. *Alexander Pedler.*

Montgomery, Jack Percival,

Agricultural College, Starkville, Miss., U.S.A.

Assistant Prof. of Chemistry, A.V.M. College of Miss.; also Assistant State Chemist of Mississipi. Author of "Some New Compounds of Urea with Acids and Salts." The above served for Dissertation for the Doctorate of Philosophy of the University of Va., the investigation being original. Graduate student at University of Va., for two years. Formerly Teacher of Natural Science, Birmingham High School, at Birmingham, Ala., and Assistant Chemist of Republic Iron and Steel Co., at same place. Present position, as above, since September, 1902.

J. W. Mallet. *J. P. Venable.*
F. P. Dunnington. *Chas. Baskerville.*

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 27/2/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 276.

Wednesday, February 17th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Mr. E. R. Buggé was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.

William Barbour, M.A., B.Sc., Grove Villa, Waltham Cross.
R. H. Durward Benn, Westmount, Montreal, Canada.
Ellis Clayton, 6, Spring Hurst Road, Saltaire.
Percy Kent Le May, 6, Lothair Villas, Hatfield, Herts.
Franklin E. Robertson, Harders Road, Peckham, S.E.
Thomas G. Shacklady, Addiscombe Villas, Cliffe-at-Hoo, Kent.

It was announced that the following changes in the Officers and Council were proposed by the Council :

As Treasurer : Dr. A. Scott, F.R.S., *vice* Dr. H. T. Brown, F.R.S.

As Secretary : Dr. M. O. Forster, *vice* Dr. A. Scott, F.R.S.

As Vice-Presidents : Dr. H. T. Brown, F.R.S., and Prof. H. B. Dixon, F.R.S., *vice* Prof. H. McLeod, F.R.S., and Prof. H. A. Miers, F.R.S.

As Ordinary Members of Council : Dr. Bernard Dyer, Mr. A. D.

Hall, Dr. A. Lapworth, Prof. J. M. Thomson, F.R.S., *vice* Dr. M. O. Forster, Mr. S. U. Pickering, F.R.S., Dr. J. A. Voelcker, and Prof. J. Walker, F.R.S.

Dr. L. T. Thorne, Dr. G. T. Moody, and Dr. J. Wade were elected to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

John Prest Ackroyd, B.Sc.
Allan Baguley, B.Sc.
Charles Thomas Bennett.
Alick Cole Benson.
George Edward P. Broderick, B.Sc.
Alfred Denys Cowper.
Julien Drugman, Ph.D.
Nevil Norton Evans.
James Rocheid Forrest.
George Fry.
Robert Gawler, M.Sc.
Anu Ghose.
Harry James Glover.
John Augustus Goodson.
John Monteath Guthrie.
Leo Frank Guttmann, Ph.D.
Alfred Henry Hoit.
Cyril Douglas McCourt.
Francis D'Oyley Mears, Jun.
Bernard Middleditch, B.A.
Jack Percival Montgomery.
Benjamin L. Murray, B.S.
Thomas S. Patterson, Ph.D.
Bertram Prentice, Ph.D., D.Sc.
Jatindranâth Sen, M.A.
Alfred Shrubsole.
Raymond Louis Siau.
Samuel John Smith.
Henry Ernest Stevenson.
Frederick Henry Streatfeild.
Charles Herbert Thompson.
Hubert Thompson, B.Sc.,
Alfred Tingle, B.Sc., Ph.D.
William Wood Underhill.
Léon Edward Walling.
Francis Langston Watt.
Charles Edward Whiteley.
William Henry Woodcock.

Of the following papers, those marked * were read :

*24. "Observations on some intramolecular and originally reversible changes extending over prolonged periods of time." By Richard John Friswell.

The question of the limitation of chemical action to a certain range of temperature was discussed in the light of W. R. Grove's experiments on the dissociation of water by heat, described in the Bakerian Lecture (*Phil. Trans.*, 1847, **137**, 1), and of recent experiments at very low temperatures, and it was pointed out that, as a rule, reactions are hastened by elevation of temperature, and hence their course has been less studied than their products.

Reference was made to V. Meyer's labile hydrogen atom, and some results obtained by the author and A. G. Green (*Trans.*, 1885, **47**, 917; 1886, **49**, 746) were discussed. It is suggested (1) that the labile condition is not confined to hydrogen, (2) that the constitution of a compound is only relative and exists only so long as the substance is submitted to a certain definite stress, (3) that different stresses develop dissimilar constitutions, and that therefore the constitution of a compound depends on its environment.

Experiments on the changes occurring during very long periods of time were described, these consisting in the slow appropriation by aminoazobenzene base from a solution of aniline hydrochloride of sufficient hydrochloric acid to saturate itself; this reaction was shown to occur even in the presence of much free aniline, and the variations due to changes of temperature were described.

These and analogous experiments are held to justify the arguments as to the effects of stress on the successive disruption of the molecules of aniline hydrochloride and aminoazobenzene hydrochloride.

Preparations illustrating the above-described experiments were exhibited.

DISCUSSION.

Dr. MORGAN suggested that the interaction occurring between aniline hydrochloride and aminoazobenzene might be explained in terms of the ordinary theories of chemical equilibrium.

Aniline hydrochloride, in aqueous solution, undergoes dissociation, and attains a state of equilibrium which may be represented approximately by the equation $C_6H_5\cdot NH_3Cl \rightleftharpoons C_6H_5\cdot NH_2 + HCl$. This equilibrium is disturbed by the introduction of aminoazobenzene, because this base forms a sparingly soluble hydrochloride and thus gradually abstracts the free acid from the solution. Excess of aniline hinders this change owing to the fact that, being itself a product of the dissociation of the soluble hydrochloride, it reverses the foregoing balanced reaction, in accordance with the law of mass action, thereby decreasing the amount of available hydrochloric acid.

Dr. HEWITT asked whether the proof of the existence of a diazonium salt in an acid solution of diazoaminobenzene during the period of isomerisation to aminoazobenzene did not depend on the coupling properties of such a solution; if so, the demonstration is not conclusive, since it has been known for years that diazoamino-compounds couple with phenols even in the absence of acids. One of the earliest known cases of this reaction was discovered by Heumann and Œconomides, who obtained benzeneazophenol from diazoaminobenzene and phenol (*Ber.*, 1887, **20**, 372).

In reply to Dr. Hewitt, Mr. FRISWELL said that a full account of the evidence for the presence of diazobenzene chloride in the solution during the conversion of the diazoaminobenzene into aminoazobenzene would be found in the papers published in conjunction with Prof. A. G. Green (*loc. cit.*). Shortly, it consisted in treating the separated solution with phenols and amines, whereby known azo-dyes were produced and identified.

In reply to Dr. Morgan, he had no objection to make to the explanation based on the suggested tendency to dissociation of aniline hydrochloride in aqueous solution. He had endeavoured to overcome this tendency by the addition of free aniline, but this only delayed the abstraction of the acid by the aminoazo-base, and, in his opinion, furnished additional evidence in favour of the stress hypothesis which he had advocated.

*25. "Note on a magnesium oxybromide." By George William Fraser Holroyd.

An ethereal solution of magnesium phenyl bromide, obtained by Grignard's method (*Ann. Chim. Phys.*, 1901, **24**, 437), when saturated with acetylene and left in a stoppered vessel for several days, deposited clear, colourless crystals having the form either of octohedra or of combinations of the octohedron and cube. The yield of crystals was about 4 grams from 50 grams of bromobenzene.

The volume of the solution before passing the acetylene was 220 c.c., and 52 grams of bromobenzene were employed. The acetylene, dried with phosphorus pentoxide, was passed through successive portions of 30 c.c. of this solution, the current of gas being continued for about 4 hours, and the flasks being kept for 2 or 3 days or longer before removing the crystals which are gradually deposited. The ethereal solution diminished to about two-thirds of its original volume during the saturation with acetylene.

The crystals, which vary considerably in size when obtained from distinct preparations, are hygroscopic and very soft; they were not recrystallised for analysis, but rapidly dried on filter paper, scraped with a sharp nickel spatula, and analysed as quickly as possible.

0·1037 gave 0·1291 AgBr. Br = 53·00.
0·0894 ,, 0·048 $MgSO_4$. Mg = 10·86.
$C_8H_{21}O_3Br_3Mg_2$ requires Br = 52·86 ; Mg = 10·49 per cent.

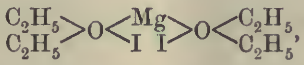
The substance is decomposed by water, heat being generated during the reaction; magnesium hydroxide is precipitated, and ether is set free.

The ether was estimated by introducing a crystal into a eudiometer standing over mercury; dry oxygen and two drops of water were then added successively, the apparatus was surrounded by a steam jacket and an electric spark passed through the gaseous mixture. The carbon dioxide produced was measured by caustic potash absorption, after decomposing any magnesium carbonate present by the addition of three drops of dilute sulphuric acid.

0·0221 gave 8·44 c.c. CO_2; $Mg_2Br_3,C_8H_{21}O_8$ requires 8·73 c.c. CO_2.
Oxygen used = 13·34 c.c.; $Mg_2Br_3,C_8H_{21}O_3$ requires 13·1 c.c. oxygen.

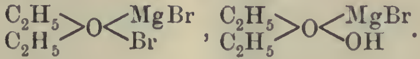
The analyses point to the formula $Mg_2Br_3{\cdot}OH,2(C_2H_5)_2O$, and the substance doubtless owes its origin to the action of small quantities of water on the magnesium phenyl bromide, $C_6H_5MgBr + H_2O = C_6H_6 + MgBr{\cdot}OH$, the magnesium oxybromide then combining with ether and magnesium bromide; the latter is always a by-product of the action of bromobenzene on magnesium in ethereal solution, the acetylene serving merely to evaporate the ether.

Zelinsky (*Chem. Centr.*, 1903, ii, 277), by the interaction of magnesium, iodine, and ether, obtained a compound to which he assigns the formula



$$\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\!>\!O\!<\!\begin{matrix}Mg\\I\end{matrix}\;\begin{matrix}Mg\\I\end{matrix}\!>\!O\!<\!\begin{matrix}C_2H_5\\C_2H_5\end{matrix},$$

and the compounds $MgBr_2,3(C_2H_5)_2O$, and $MgBr_2,(C_2H_5)_2O$, have also been produced. Zelinsky considers that these compounds play the *rôle* of catalysts in the formation of the mixed organo-magnesium compounds. The compound obtained by the author is evidently related to these products, and should perhaps be represented by the formula



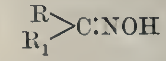
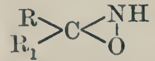
$$\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\!>\!O\!<\!\begin{matrix}MgBr\\Br\end{matrix},\;\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\!>\!O\!<\!\begin{matrix}MgBr\\OH\end{matrix}.$$

*26. "The arrangement in space of the groups combined with the tervalent nitrogen atom." By Frederic Stanley Kipping and Arthur Henry Salway.

The Hantzsch and Werner hypothesis regarding the tervalent nitrogen atom indicates the existence of enantiomorphously related isomerides in compounds of the type $NR_1R_2R_3$, and one of the objects of this investigation was either to isolate, if possible, such isomerides or to demonstrate their non-existence.

Since an externally compensated acid chloride may be used for the detection of asymmetry in bases where the asymmetry is due to a carbon atom (Kipping and Hall, *Trans.*, 1901, 79, 444), it seemed probable that, if tervalent nitrogen compounds were asymmetrical, their asymmetry could be detected in like manner, but no evidence of the existence of isomerides was obtained on examining the products of the interaction of *dl*-benzylmethylacetyl chloride with methylaniline, *p*-toluidine, benzylaniline, and phenylhydrazine. *p*-Toluidine and benzylaniline also gave negative results with optically active benzylmethylacetyl chloride. Although the introduction of one centre of asymmetry failed to afford separable isomerides, it seemed highly probable that the introduction of a second centre of asymmetry would give a satisfactory result if enantiomorphously related derivatives of tervalent nitrogen were really capable of existence. The products from *d*-benzylmethylacetyl chloride and *l*-menthylamine, *d*-hydrindamine, *l*-methylhydrindamine, and *l*-phenylethylamine, however, retained their uniform character after fractional crystallisation. These results indicate that the three radicles, together with the tervalent nitrogen itself, are situated in one plane; that two of the radicles are symmetrically arranged with respect to the third, and that in all probability this is true of any two, that is to say the whole arrangement is the most symmetrical one possible.

The substituted amides derived from the interaction of benzylmethylacetyl chloride and the foregoing inactive and active bases were described.

Assuming that the isomerism of the syn- and anti-forms of oximes is structural and represented by the formulæ  $\begin{smallmatrix}R\\R_1\end{smallmatrix}\!>C\colon NOH$ and  $\begin{smallmatrix}R\\R_1\end{smallmatrix}\!>C<\begin{smallmatrix}NH\\|\\O\end{smallmatrix}$, the latter structure, since it contains an asymmetric carbon atom, should exist in enantiomorphously related forms, and the introduction of an optically active acid chloride should produce two non-enantiomorphously related separable isomerides. The action of benzylmethylacetyl chloride on benzoinoxime was studied, but instead of the desired acyl derivative, the following products were obtained: benzil, benzoin, benzaldehyde, benzonitrile, ammonium chloride, hydrogen chloride, and benzylmethylacetic acid, together with a compound melting at 126°. Attempts to obtain a benzylmethylacetyl derivative from *a*-benzaldoxime were also unsuccessful, decomposition taking place with the formation of benzonitrile.

Benzoyl chloride interacts normally with benzoinoxime, giving *benzoinoxime benzoate*, $CHPh(OH)\cdot CPh\colon NOBz$, which crystallises from alcohol in leaf-like plates melting at 165—166°.

Benzoylbenzoinoxime, $CHPh(OBz)CPh\colon NOH$, prepared by treating benzoylbenzoin with hydroxylamine, crystallises from alcohol in globular clusters melting at 148°.

dl-Benzylmethylacetyl chloride gives, with *dl*-hydrindamine, two isomeric *dl*-benzylmethylacetohydrindamides, which can be easily separated; these two compounds melt at 110—111° and 119·5° respectively, and their formation affords proof of the asymmetry of the hydrindamine molecule.

d-Benzylmethylacetyl chloride and *dl*-hydrindamine give a mixture of the isomeric amides *dAdB* and *dAlB*, from which the derivative of the *d*-base is easily isolated; the enantiomorphously related components of *dl*-α-phenylethylamine may be separated in a similar manner, the compound, $CH_2Ph\cdot CHMe\cdot CO\cdot NH\cdot CHMePh$, of the *l*-base being easily isolated.

27. "The esterification of *r*-mandelic acid by menthol and borneol." By Alexander McKenzie.

The results recorded in this research deal with the method of resolving *i*-compounds devised by Marckwald and the author (*Ber.*, 1899, **32**, 2130; 1900, **33**, 208; 1901, **34**, 469. Compare Walden, *Ber.*, 1899, **32**, 2703; E. Fischer, *Ber.*, 1899, **32**, 3617).

When *r*-mandelic acid was heated with *l*-borneol, the unesterified acid was lævorotatory, whilst the mixture of esters yielded a lævorotatory acid. When *l*-bornyl *dl*-mandelate was submitted to fractional hydrolysis, a lævorotatory acid was obtained from the initial hydrolysis, and an inactive acid from the final hydrolysis of the residual esters by an excess of alcoholic potassium hydroxide. *d*-Mandelic acid was isolated from the dextrorotatory acid obtained from the initial hydrolysis of *l*-menthyl *dl*-mandelate. *l*-Menthyl *dl*-mandelate can yield either a dextrorotatory or a lævorotatory acid from the initial fractional hydrolysis according to the amount of alkali used. *l*-Menthyl *dl*-mandelate boils at 225° under 30 mm. pressure and melts at 85—86°; it has $[\alpha]_D^{18°} -74\cdot2°$ ($c = 10\cdot890$) in ethyl-alcoholic solution; it is partially racemic, and is not resolved into *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate when repeatedly crystallised from light petroleum at the temperature of the laboratory. Potassium *l*-mandelate is completely racemised when heated with a large excess of potassium hydroxide in aqueous or ethyl-alcoholic solution.

28. "Certain organic phosphorus compounds." By Augustus Edward Dixon.

In pursuing the study of the interaction of phosphorus halides with metallic thiocyanates (*Trans.*, 1901, **79**, 541), the author has now succeeded in isolating phosphorus and phosphoryl "thiocyanates" respectively.

Phosphorus trithiocyanate, $P(CNS)_3$, obtained from phosphorus trichloride and dry ammonium thiocyanate in presence of benzene, is an almost colourless oil boiling at 163° under 15 mm. pressure, and having a sp. gr. 1·487 at 15·5°. When treated with water, a portion was quickly hydrolysed, forming phosphorous and thiocyanic acids;

the remainder was hydrolysed exceedingly slowly, but otherwise no material difference in properties or composition was observed between this residue and a distillate not subjected to the action of water.

Phosphoryl trithiocyanate, $PO(CNS)_3$, obtained from phosphorus oxychloride, is a clear, pale yellow, highly refractive oil, boiling at 175° under 21 mm. pressure, and completely hydrolysed by cold water into phosphoric and thiocyanic acids, together with some *iso*perthiocyanic acid, resulting from the interaction of these products; it has a sp. gr. 1·520 at 13·5°.

These substances not only behave as thiocyanates, but also, to some extent, manifest the properties of thiocarbimides, being freely desulphurised by alkaline salts of lead and silver; they unite spontaneously with aniline, &c., fixing either one or three molecular proportions, according to the amount presented, to form amorphous solids, insoluble in cold water. The additive products are readily hydrolysed by contact with hot water, yielding in all cases approximately one molecular proportion of monosubstituted thiourea; a little hydrogen sulphide is evolved, but otherwise the rest of the contained sulphur appears as thiocyanic acid.

Certain tests which have been employed to distinguish between thiocyanates and thiocarbimides (such as treatment of the alcoholic solution with sodium, or the action of thioacetic acid) cannot be safely accepted as final where acyl thiocyanates are concerned, all the latter so far examined being tautomeric in the sense that, under suitable conditions, they can behave as thiocarbimides to a greater or less extent if their power in this direction is measured by their capacity to fix aniline in the form of an immediate derivative of normal phenylthiocarbamide.

The study of these supposed tautomeric phenomena is being continued.

29. "Note on the relation between the chemical composition of some organic substances and the density of their solutions." By Charles Edward Fawsitt.

The density of aqueous solutions of different salts in equivalent quantities is an additive property, and the principal relations are given by Valson's Law of Moduli. The relation of density in solutions of organic compounds (feeble electrolytes or non-electrolytes) to chemical composition or constitution is not yet so fully understood.

The author, in continuing an investigation on the amides (*Proc. Roy. Soc. Edin.*, 1904, 25, 51), has measured the density of aqueous solutions of a number of amides at 25°, when the solutions contained the gram-molecular weight of the substance dissolved in one litre The densities of urea, methylurea, and *as*-dimethylurea solutions are 1·0155, 1·0137, and 1·0107 respectively; a comparison of these numbers with those obtained by Kanitz (*Zeit. physikal. Chem.*, 1897, 22, 336) for ammonia, methylamine, and dimethylamine, namely, 0·9932, 0·9886, and 0·9856, shows that the differences for the corresponding numbers are fairly close to one another.

The densities of solutions of acetamide, propionamide, and butyramide are 1·0040, 1·0028, and 1·0006.

The values obtained for acetic, propionic, and butyric acids by Reyher (*Zeit. physikal. Chem.*, 1888, 2, 744) are 1·0084, 1·0066, and 1·0040, and show a similar relationship.

From these results, it will be seen that the density of such solutions is to a great extent an additive property, but constitution also plays some part, because isomeric substances give different values.

30. "The so-called 'hydrocellulose.'" By Arthur Landauer Stern.

When cellulose is exposed to the action of dilute acids under certain conditions, the tenacity of the fibres is destroyed, and it falls to a powder which has been called hydrocellulose, and stated to have the empirical formula $C_{12}H_{22}O_{11}$.

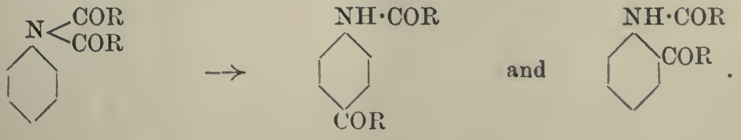
It is now shown that when the above reaction takes place, instead of a gain in weight, as theory indicates, there is invariably a loss, and that a small amount of soluble matter is formed, a portion of which, in all probability, is *d*-glucose.

The elementary composition of the powder is also shown to be identical with that of cellulose, the previous statements bearing on this point being founded on faulty experimental methods.

A hydrated cellulose is not formed under these conditions, but a hydrolysis takes place similar to that undergone by other carbohydrates under comparable conditions.

31. "Isomeric change of diacylanilides into acylaminoketones." By Frederick Daniel Chattaway.

When the diacylanilides are heated in presence of hydrogen chloride or zinc chloride, intramolecular rearrangement takes place and the isomeric acylaminoketones are produced thus:



Such isomeric changes as have been studied follow an exactly similar course to that of other analogous transformations in which atoms or groups of atoms pass from the nitrogen into an ortho- or para-position in the ring.

The introduction of a second acyl group into the nucleus has, however, not yet been effected (compare *Proc.*, 1902, **18**, 173 ; 1903, **19**, 50, 57, 106, 124).

32. "Intramolecular rearrangement in derivatives of the aromatic aminoketones." By Frederick Daniel Chattaway.

The acylchloroamino-derivatives of the aromatic ketones readily undergo the intramolecular rearrangement characteristic of substituted aromatic chloroamines in which the halogen linked to the nitrogen changes place with a hydrogen atom attached to the ring in an ortho- or para-position. The conditions necessary for the transformations to take place were indicated, and a series of new aromatic chloroaminoketones with their acyl derivatives was described.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday**, March 23rd, at **half-past five** o'clock in the afternoon.

At the next Meeting, on **Thursday**, March 3rd, 1904, at **8** p.m., the following papers will be communicated :—

"Chemical dynamics of the alkyl iodides." By K. A. Burke and F. G. Donnan.

"The constitution of phenolphthalein." By A. G. Green and A. G. Perkin.

"δ-Ketohexahydrobenzoic acid." By W. H. Perkin, jun.

"Photochemically active chlorine." By C. H. Burgess and D. L. Chapman.

"The separation of β-crotonic acid from α-crotonic acid." By R. S. Morrell and A. E. Sellars.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 11/3/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 277.

Thursday, March 3rd, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. W. W. Underhill and J. A. Goodson were formally admitted Fellows of the Society.

THE PRESIDENT announced that arrangements had been made for the delivery of a Faraday Lecture this year. The invitation addressed in the first instance to Professor Emil Fischer had been accepted and a date in November last had been selected for the lecture, but to the great regret of the Council the state of Professor Fischer's health had prevented him from fulfilling his engagement. Professor Ostwald, of Leipzig, had, however, been good enough to accept an invitation to give the lecture on April 19th next, and by the courtesy of the authorities of the Royal Institution the discourse would be delivered in the Theatre of that Institution. Arrangements as to the admission of Fellows of the Society would be announced later in the Proceedings.

Certificates were read for the first time in favour of Messrs.

Robert S. Finlow, Pemberandah, Dalsingh Serai, India.
Robert de J. Fleming-Struthers, B.A., Exeter College, Oxford.
George Mathieson Horn, Ivylands, Epping.
Alfred Mander, Berkswell, Malvern.
Gerald Pinchbeck, 96, Albany Street, Regents Park, N.W.
Walter Tong, Pole Lane, Failsworth, Manchester.

Of the following papers, those marked * were read :

*33. "Chemical dynamics of the alkyl iodides." By Miss Katherine A. Burke and Frederick George Donnan.

The reactions between silver nitrate and certain of the alkyl iodides in absolute alcoholic solutions were shown to be very complicated, and the main conclusions deduced are summarised as follows :

1. The reactions between silver nitrate and an alkyl iodide in absolute alcohol at 24·5° and at concentrations varying from $N/20$ to $N/80$ can be expressed by a special form of the bimolecular velocity-equation, in which the velocity-coefficient is a function of the initial concentration of the reacting components.

2. It is found that in solutions containing the reagents in equivalent amounts, the velocity-coefficient (k) increases as the initial molecular concentration (c) increases, the relation between k and c being $k = Kc^{0 \cdot 53}$, where K is independent of concentration.

3. This variation of k is chiefly due to the silver nitrate. For solutions containing the same ($N/40$) initial concentration of ethyl iodide and varying ($N/20$—$N/80$) initial concentration (c) of silver nitrate, the relation between k and the latter is approximately $k = Kc^{\frac{2}{3}}$. For solutions containing the same initial concentration of silver nitrate and varying initial concentration of ethyl iodide, the value of k decreases as the latter increases, but the rate of decrease is relatively small as compared with the rate of increase produced by silver nitrate.

4. It has not been found possible to explain the variation of k indicated in 1, 2, and 3. In particular, the assumption that it is the silver ions which take part in the fundamental reaction which regulates the speed does not appear to offer a simple explanation.

5. Similar anomalies have been observed by Hecht, Conrad, and Brückner in the case of ether-formation from sodium alkyloxide and alkyl iodide in alcoholic solution, but the explanation of these anomalies proposed by Steger, based on assumptions concerning the ionisation of the sodium alkyloxide in alcoholic solution, does not appear to be valid if the ordinary law of equilibrium is assumed.

6. The theory of "alkylene" and "alkylidene" dissociation of the alkyl iodides, proposed by Nef, does not give a satisfactory account of the observed results.

7. As stated by Nef, nitric acid is the only acid produced in the reaction. Chiminello's statement that acetic acid is formed appears

to be incorrect. The other products of the reaction are ether and alkyl nitrate.

8. If the reactivities of the alkyl iodides are measured by the velocity-coefficients of the reaction with silver nitrate in absolute alcohol ($N/40$ equivalent solutions at 24·5°), the order of reactivity (beginning with the greatest) is *iso*propyl, ethyl, *n*-propyl, methyl, *n*-butyl, *iso*amyl, *iso*butyl.

9. This order of reactivities corresponds with the rate of production of free iodine in the alcoholic solutions when exposed to air and light, with the single exception of methyl iodide, the solution of which becomes discoloured at a rate between those of solutions of *iso*propyl and ethyl iodides.

10. The relative reactivities referred to in (8) do not agree in many respects with those observed in other reactions which have been studied kinetically, such as the reactions with ethyl sodioacetoacetate, triethylamine, sodium alkyloxide. Compared with these results, *iso*propyl iodide reacts with abnormally great, and methyl iodide with abnormally small velocity. It does not appear possible, therefore, to ascribe the reactivity of the alkyl haloids to any uniform cause (such, for example, as a dissociation, whether "alkylidene," "alkylene," or electrolytic).

11. So far as the final products and not the kinetics of the reaction are concerned, the production of ether and nitric acid can be explained by ionic reactions just as well as by Nef's hypothesis.

*34. "Separation of β-crotonic acid from α-crotonic acid." By Robert Selby Morrell and Albert Ernest Bellars.

The separation of β-crotonic acid from α-crotonic acid was formerly effected by means of the different solubilities of the sodium salts in alcohol (Michael and Schulthess, *J. pr. Chem.*, 1892, [ii], **46**, 245), the β-crotonate being more soluble in absolute alcohol than its α-isomeride. The β-crotonic acid thus obtained was considered by J. Wislicenus to be not entirely free from the α-acid (*Chem. Centr.*, 1897, ii, 259).

The salts of β-crotonic acid with brucine and quinine have been found to be less soluble than the corresponding derivatives of α-crotonic acid. The brucine salts are unfortunately very soluble in most solvents, but the quinine salts are very sparingly soluble in water, and it is easy to separate quinine β-crotonate (m. p. 157°) from quinine α-crotonate (m. p. 134°) by fractional crystallisation; the solubility of the β-crotonate in water at 17° is 1·0, whilst that of the α-crotonate is 2·4 at the same temperature, and two crystallisations are sufficient to complete the separation.

The barium β-crotonate, $Ba(C_4H_5O_2)_2,H_2O$, obtained from the quinine salt, when suspended in pure ether and decomposed by dilute sulphuric acid, yielded the pure β-crotonic acid (m. p. 15°, sp. gr. 1·0342 at 12·5°). Its physical and chemical properties agree with those described by Michael and by J. Wislicenus (*loc. cit.*). The molecular weight in glacial acetic acid is 85·6, and the molecular refraction is 37·2.

The advantage of the following method of separation lies in the fact that fractional distillation of the two acids is avoided, and it is easier to obtain the less soluble quinine β-crotonate in a pure state than to remove sodium α-crotonate completely from the more soluble sodium β-crotonate.

*35. "Contributions to the knowledge of the β-diketones." By Siegfried Ruhemann and Edwin Roy Watson.

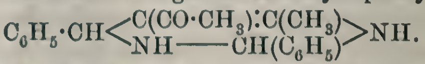
The authors have repeated Wislicenus's experiments on the action of alcoholic potash in benzylideneacetophenone dibromide and find that the compound produced has the empirical formula $C_{17}H_{16}O_2$, and not $C_{15}H_{12}O_2$, as stated by Wislicenus (*Annalen*, 1899, **308**, 219), and that it is the ethyl ether of dibenzoylmethane, $C_6H_5\cdot C(O\cdot C_2H_5){:}CH\cdot CO\cdot C_6H_5$. Under the influence of hydrochloric acid, the substance decomposes into ethyl chloride, acetophenone, and benzoic acid.

Alcoholic potash behaves similarly towards the dibromide of *p*-nitrobenzylideneacetophenone, $C_6H_4(NO_2)\cdot CHBr\cdot CHBr\cdot CO\cdot C_6H_5$, yielding the ethyl ether of *p*-nitrodibenzoylmethane,

$$C_6H_4(NO_2)\cdot C(O\cdot C_2H_5){:}CH\cdot CO\cdot C_6H_5$$

(m. p. 89—90°).

The authors have also examined the action of ammonia and organic bases on the olefinic diketones. Thus benzylideneacetylacetone reacts with aniline to form the compound $C_6H_5\cdot CH(NH\cdot C_6H_5)\cdot CH(CO\cdot CH_3)_2$ (m. p. 113°). This, on heating, decomposes into benzylideneaniline and acetylacetone. Phenylhydrazine reacts with benzylideneacetylacetone and also with benzylidenebenzoylacetone with evolution of heat. The additive compounds could not be obtained, since, in each case, they are decomposed at once with the formation of benzaldehyde phenylhydrazone.

With benzylideneacetylacetone, alcoholic ammonia forms the compound $C_{19}H_{20}ON_2$ (m. p. 147°), which is to be regarded as acetyldiphenylmethyltetrahydropyrimidine,  $C_6H_5\cdot CH{<}\begin{array}{l}C(CO\cdot CH_3){:}C(CH_3)\\ NH\text{———}CH(C_6H_5)\end{array}{>}NH$.

The diketones react with semicarbazide with the elimination of 1 molecule of water and the formation of $C_{13}H_{15}O_2N_3$ (m. p. 210° with decomposition) and $C_{18}H_{17}O_2N_3$ (decomposing at 230°). These compounds may be regarded as semicarbazones, but taking into consideration the behaviour of other bases towards the diketones, the alternative view of representing them as cyclic compounds cannot be disregarded.

The additive compound obtained from benzamidine and benzylidenebenzoylacetone (*Trans.*, 1903, 83, 1372) may also be regarded as being formed by the addition of the base to the ethylenic linking of the olefinic ketone.

*36. "The purification of water by continuous fractional distillation." By William Robert Bousfield.

An apparatus was described in which water is distilled continuously from a copper boiler, freed from spray by means of a system of baffle plates, and condensed on surfaces kept at different temperatures by an adjustable supply of cold water. The hottest surfaces yield distilled water of ordinary quality, whilst the coldest surfaces give water of conductivity 1 to 2 reciprocal megohms per c.c., which is sufficiently pure for the majority of conductivity measurements, and contains only a small proportion of ammonia.

*37. "Freezing point curves of dynamic isomerides. Ammonium thiocyanate and thiocarbamide." By Alexander Findlay.

The author has studied the equilibrium relations of the dynamic isomerides, ammonium thiocyanate and thiocarbamide from the point of view of the phase rule, attention being directed chiefly to the determination of the freezing points of mixtures of these substances with the view of ascertaining what compounds, if any, are formed at temperatures in the neighbourhood of the freezing points, and the conditions of their stability (compare Emerson Reynolds and Werner, *Trans.*, 1903, 83, 1). The freezing point curve obtained is of the simplest form, consisting of two branches meeting at a eutectic point which lies about 104·3°. The melting points of ammonium thiocyanate and of thiocarbamide can be determined only approximately on account of the occurrence of isomeric transformation. The melting point of ammonium thiocyanate may be taken as being about 149° and that of thiocarbamide as not lower than 175--177°, these being determined by comparison with camphor. The natural freezing point is 114—115°, the stable form being ammonium thiocyanate. From the simple form of the freezing point curve obtained, it follows that no compound is formed which is stable at the temperatures indicated on this curve. This conclusion is supported by the form of the cooling curve and by the analysis of the solid phase.

From the fact that the equilibrium point in the liquid phase is independent of the temperature, it follows that the isomeric transformation is not accompanied by any heat effect.

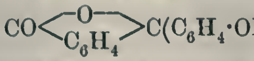
38. "The constitution of phenolphthalein." By Arthur George Green and Arthur George Perkin.

The authors have found that a solution of phenolphthalein, decolorised by an excess of caustic alkali, can be entirely neutralised, without any return of the colour taking place, by careful titration at a low temperature with dilute acetic acid. If, however, the colourless neutral solution is boiled, the red colour returns in its full intensity, whilst at the same time the solution becomes alkaline. If the solution is acidified and either left for some time or heated, a precipitation of free phenolphthalein occurs, which also dissolves in aqueous alkalis to a red solution. The point at which neutrality occurs in the titration with acetic acid corresponds with the presence in the colourless solution of the carbinolcarboxylic acid salt,

$$C_6H_4(CO_2M){\cdot}C(OH)(C_6H_4{\cdot}OH)_2.$$

These observations do not agree with the electrolytic dissociation hypothesis, but are simply explained by the quinonoid theory if the colour changes are attributed to a variation of type from a quinonoid to a benzenoid form and *vice versâ*, due to hydration and dehydration.

Thus, the first action of an alkali on the free phenolphthalein (lactone) would probably be the replacement of the phenolic hydrogen by the alkali metal. This salt being unstable may be supposed to undergo immediate transformation into the coloured quinonoid salt, $C_6H_4(CO_2K){\cdot}C(C_6H_4{\cdot}OH){:}C_6H_4{:}O$, by direct transference of the metal from the phenolic to the carboxylic group.

With excess of caustic alkali, this coloured salt is converted, by assumption of KOH, into the colourless carbinol salt, $C_6H_4(CO_2K){\cdot}C(OH)(C_6H_4{\cdot}OH){\cdot}C_6H_4{\cdot}OK$, and this product, when neutralised with acetic acid, gives $C_6H_4(CO_2K){\cdot}C(C_6H_4{\cdot}OH)_2{\cdot}OH$, which is also colourless. Caustic potash is set free on boiling the latter salt, and the lactone,  $\mathrm{CO}\Big<{}^{\mathrm{O}}_{\mathrm{C_6H_4}}\Big>\mathrm{C(C_6H_4{\cdot}OH)_2}$, which is produced is simultaneously converted into the coloured quinonoid salt by the liberated alkali.

A similar explanation is offered in the case of quinolphthalein, the behaviour of which is found to be exactly similar to that of phenolphthalein.

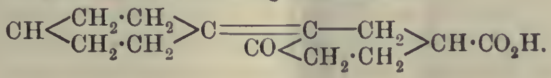
39. "δ-Ketohexahydrobenzoic acid." By William Henry Perkin, jun.

Ethyl γ-cyanopentane-αγε-tricarboxylate,

$$CO_2Et\cdot C(CN)(CH_2\cdot CH_2\cdot CO_2Et)_2,$$

is readily prepared by the interaction of ethyl β-iodopropionate with the sodium compound of ethyl cyanoacetate; it boils at 228° under 20 mm. pressure, and, on hydrolysis with hydrochloric acid, yields pentane-αγε-tricarboxylic acid, $CO_2H\cdot CH(CH_2\cdot CH_2\cdot CO_2H)_2$ (compare Emery, *Ber.*, 1891, **24**, 384; Bottomley and Perkin, *Trans.*, 1900, **77**, 299). On digesting this acid with acetic anhydride and distilling the product under diminished pressure, water and carbon dioxide are eliminated, and *δ-ketohexahydrobenzoic acid* (cyclo*hexanone*-4-*carboxylic acid*) is produced, which crystallises with one molecule of water, melts at 68°, and distils at 210°/30 mm. It was further characterised by means of its *oxime*, *semicarbazone*, and *methyl* and *ethyl* esters.

The ketonic acid forms an oily phenylhydrazone, which, on heating with hydrochloric acid, yields *tetrahydrocarbazole*-p-*carboxylic acid* (m. p. 195°) (compare Baeyer and Tutein, *Ber.*, 1889, **22**, 2184). δ-Ketohexahydrobenzoic acid, when digested with methyl alcohol and sulphuric acid, yields *ethyl carboxyhexamethenyl-δ-ketohexahydrobenzoate* (b. p. 255°/20 mm.). This ester, on hydrolysis, yields the acid, which melts at 170° and has the following constitution:



$$\mathrm{CH}<\begin{matrix}\mathrm{CH_2\cdot CH_2}\\\mathrm{CH_2\cdot CH_2}\end{matrix}>\mathrm{C}\underset{\mathrm{CO}<}{=\!=\!=\!=}\mathrm{C}\begin{matrix}\mathrm{-CH_2}\\\mathrm{CH_2\cdot CH_2}\end{matrix}>\mathrm{CH\cdot CO_2H}.$$

trans-*Hydroxyhexahydrobenzoic acid*, produced by reducing δ-ketohexahydrobenzoic acid, melts at 121°, and, when heated with hydrobromic acid, is converted into trans-*δ-bromohexahydrobenzoic acid* (*bromo*cyclo*hexane*-4-*carboxylic acid*) (m. p. 167°), and this, when digested with sodium carbonate, loses hydrogen bromide, yielding Δ^3-*tetrahydrobenzoic acid*, which melts at about 13° and distils at 237°/748 mm.; it combines with hydrobromic acid to form *γ-bromohexahydrobenzoic acid* (m. p. 122°), and also absorbs bromine at the ordinary temperature, yielding *γδ-dibromohexahydrobenzoic acid* (m. p. 86°).

δ-Ketohexahydrobenzoic acid combines with hydrogen cyanide, and from the product, the *nitrile* of trans-*α-hydroxyhexahydroterephthalic acid*, $OH\cdot C(CN)[CH_2\cdot CH_2]_2\cdot CH\cdot CO_2H$, was isolated in the form of pale yellow crystals melting at about 140°. This nitrile yields, on hydrolysis, trans-*α-hydroxyhexahydroterephthalic acid* (m. p. 228—230°). If the crude product of the action of hydrogen cyanide on ketohexahydrobenzoic acid is hydrolysed, the principal product obtained is *α-hydroxyhexahydroterephthalic acid* (m. p. 168—170°).

Both *cis*- and *trans*-hydroxy-acids are decomposed on distillation, with loss of water and formation of Δ^1-*tetrahydroterephthalic acid* (Baeyer, *Annalen*, 1888, **245**, 160).

The investigation of δ-ketohexahydrobenzoic acid is being continued.

40. "Photochemically active chlorine. A preliminary notice." By Charles Hutchens Burgess and David Leonard Chapman.

By taking advantage of several new facts, the authors have succeeded in showing that the activity of a mixture of hydrogen and chlorine depends entirely on the condition of the chlorine. Draper originally maintained that this was the case, but Bunsen and Roscoe were unable to repeat his experiments, and Mellor, accepting the results of Bunsen and Roscoe, has constructed his working hypothesis on the assumption that Draper is wrong. P. V. Bevan (*Phil. Trans.*, 1903, **202**, 71) has quite recently shown that similar mixtures of hydrogen with insolated and uninsolated chlorine exposed to light under the same conditions behave somewhat differently, the period of induction of the former being slightly shorter. The work of Bevan shows that before hydrochloric acid can be formed some change in the chlorine alone must take place, but it may also be necessary for a further change to occur which can only be effected in the presence of hydrogen, or, in terms of this author's hypothesis, it may first be necessary for complex molecules of chlorine and water to be formed, and then for the hydrogen to react with these forming complexes containing water, chlorine, and hydrogen, both changes requiring a finite time for their completion.

That a saturated solution of chlorine in water can exist either in an active or in an inactive condition is shown in the following way. A mixture of hydrogen and chlorine contained in a Bunsen and Roscoe's actinometer was exposed to light until the period of induction was passed. It was then vigorously shaken so as to mix the gas and liquid thoroughly. When the mixture was again exposed to light, a second period of induction was observed, which, however, was not so long as the first. A still shorter period of induction was indicated when the mixture had again been shaken, until after repeating the above process several times no difference could be noticed in the rate of combination before and after shaking, thus proving that the liquid in the bulb had become active. The change which precedes the formation of hydrogen chloride undoubtedly extends to the aqueous solution.

It was next shown that a mixture of hydrogen and chlorine which had passed through the period of induction could again be rendered inactive by shaking the mixed gases with either water, hydrochloric acid, hypochlorous acid, or chlorine water, and further that a mixture of hydrogen and chlorine which had been agitated with water showed a much longer period of induction than one which had not been thus treated.

An apparatus was devised into which chlorine could be passed and treated in any desired manner before being mixed with hydrogen. Into this apparatus, chlorine was passed and shaken with water. The chlorine water thus formed was removed, and the gas again shaken with a fresh supply of water, the operation being repeated several times. The chlorine which had been thus treated was then mixed with an equal volume of hydrogen and exposed to light, when the period of induction lasted for over an hour.

In the next experiment, the chlorine was constantly shaken with the liquid contained in the apparatus and exposed to a strong light in order to render both the liquid and the gas active; the gas was then mixed with hydrogen in the dark and exposed to light. There was no period of induction; combination of hydrogen and chlorine took place immediately, and no variation in the rate of combination could be observed throughout the reaction.

These results indicate (1) that a solution of chlorine exists either in an active or in an inactive state; (2) that the period of induction is entirely due to the condition of the chlorine.

41. "The union of hydrogen and chlorine. VIII. The action of temperature on the period of induction." By Joseph William Mellor.

Measurements of the duration of the period of induction at different temperatures from 3° up to 50° show (i) that the period is shorter the higher the temperature; (ii) that above 38°, disturbing effects, probably due to the presence of water vapour, obscure the influence of the increased temperature.

42. "The union of hydrogen and chlorine. IX. Further experiments on the action of light on chlorine." By Joseph William Mellor.

Bevan has recently shown that the activity of chlorine after exposure to sunlight, first observed by Draper, is destroyed by bubbling the chlorine through water, as in Bunsen and Roscoe's experiment. Bevan supposes that the union with hydrogen still proceeds through the intervention of the intermediate compound, $x\text{Cl}_2,y\text{H}_2\text{O},z\text{H}_2$, as suggested in the author's paper (*Trans.*, 1902, 81, 1280). Two bulbs of ordinary moist chlorine were exposed to sunlight for ten minutes and afterwards mixed with moist hydrogen. The duration of the period of induction with this mixture was compared with that of a similar mixture made in darkness. Two more bulbs of chlorine, dried with phosphoric oxide, were treated in exactly the same way. The periods of induction were relatively as follows, the expansion being corrected for the Budde effect.

Standard	Moist	Dry
1	0·5	1·0
1	0·3	0·9

The results show that the greater chemical activity of insolated chlorine is intimately associated with the presence of steam. The alternative hypothesis, put forward in the above-cited paper, is just as satisfactory as the intermediate compound theory.

43. "Additive compounds of unsaturated cyclic ketones with hydrogen cyanide." By Archie Cecil Osborne Hann and Arthur Lapworth.

The applicability of the general method for bringing about the addition of hydrogen cyanide to the ethylenic union in $\alpha\beta$-unsaturated ketones, nitriles, &c., recently worked out by one of us (Trans., 1903, **83**, 999), is being systematically investigated, particularly with regard to the open chain and cyclic ketones and aldehydes.

Carvone, in presence of potassium cyanide, unites with one molecular proportion of hydrogen cyanide in the cold. The product, which is formed in nearly quantitative amount, is a *nitrile*, $C_{10}H_{15}O\cdot CN$, melting at 93·5—94·5°, which, on hydrolysis, yields two isomeric unsaturated *acids*, $C_{10}H_{15}O\cdot CO_2H$, melting at 137° and 96—97°. The foregoing nitrile gives a *cyanohydrin*, $CN\cdot C_{10}H_{15}(OH)\cdot CN$, melting at 106—108°, which is easily hydrolysed, forming the *acids* $C_{12}H_{17}O_3N$ and $C_{12}H_{16}O_4$, which are possibly mixtures of isomerides.

Pulegone behaves somewhat similarly; the first additive product is the *nitrile*, $C_{10}H_{17}O\cdot CN$, which melts at 160·5°.

A number of other derivatives of the foregoing compounds have been obtained, and will be described in due course.

44. "The formation of periodides in organic solvents." By Harry Medforth Dawson.

The formation of potassium periodides in various organic solvents has been studied by determining the composition of such solutions when saturated either with potassium iodide or with iodine.

The aromatic nitro-compounds investigated, such as nitrobenzene, *o*-nitrotoluene, *m*-nitrotoluene and *o*-nitroanisole, show a very similar behaviour, and under conditions favourable to the formation of the highest possible periodide, namely, saturation of the solution with regard to iodine, the enneaiodide, KI_9, is the essential component of the solutions. The composition of the solutions saturated with respect to potassium iodide indicates that increasing concentration favours the formation of periodides of gradually increasing complexity.

By a method devised for the study of solid aromatic nitro-compounds, it is shown that these exert an influence on the formation of soluble periodides which is in many respects similar to that of nitrobenzene.

Other solvents, including nitromethane, nitropentane, ethyl alcohol, propionitrile, ethyl acetate, ethyl bromide and *iso*butyl alcohol, have also been investigated.

45. "The action of sodium hypochlorite on the aromatic sulphonamides." By Henry Stanley Raper, John Thomas Thompson, and Julius Berend Cohen.

The authors have continued the investigation described in the preliminary notice published in the *Proceedings* (1901, **17**, 262), and have added the following facts.

*Benzenesulphon-*o*-toluidide* (m. p. 123—124°), when dissolved in acetic acid and treated with sodium hypochlorite, yields the *chloroamide*, $C_7H_7\cdot NCl\cdot SO_2\cdot C_6H_5$, melting at 99—100°; this product, on heating with acetic acid, gives benzenesulphon-5-chloro-*o*-toluidide (m. p. 124—125°). *Benzenesulphon-*m*-toluidide* (m. p. 95°) gives a sodium compound, $C_6H_3Cl(CH_3)\cdot NNa\cdot SO_2\cdot C_6H_5$, melting at 275—280°, which is decomposed by acetic acid and yields benzenesulphon-6-chloro-*m*-toluidide. With an excess of hypochlorite, benzenesulphon-2 : 6-dichloro-*m*-toluidide (m. p. 114°) is formed. *Benzenesulphon-*p*-toluidide* forms benzenesulphon-3-chloro-*p*-toluidide (m. p. 110°).

*Benzenesulphon-*4-m*-xylidide* (m. p. 124—125°) gives benzenesulphon-5-chloro-4-*m*-xylidide (m. p. 148—149°) when heated with the hypochlorite solution at 50°.

Benzenesulphon-α-naphthalide (m. p. 168°) is quite unaffected by the hypochlorite even on warming. *Benzenesulphon-β-naphthalide* (m. p. 97—98°) forms a sodium compound, which, when decomposed with acid, gives benzenesulphon-1-chloro-*β*-naphthalide (m. p. 130—131°).

Chattaway and Orton have shown that by the action of sodium hypochlorite on the acyl derivatives of the aromatic amino-compounds, the halogen in the first instance enters the ring in the para-position with respect to the amino-group, and then selects the ortho-position. The orienting effect of the sulphonic group is different. The foregoing results show that in the first instance the halogen seeks the ortho-position with respect to the amino-group. If a methyl group is present and if the para-position to the amino-group is free, the conditions are modified and the halogen enters either the ortho-position to the methyl radicle or the para-position to the amino-group. It is interesting to note that the action of the hypochlorite is retarded in the *o*-substituted sulphonamides; those of *o*-toluidine and xylidine react with difficulty, whilst that of α-naphthylamine, which may be regarded as an ortho-substituted compound, is quite unchanged.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday,** March 23rd, at **half-past five** o'clock in the afternoon.

THE FARADAY LECTURE.

The Faraday Lecture will be delivered by Professor W. Ostwald on **Tuesday,** April 19th, at **8.30** p.m.

This Lecture will be delivered, by the kind permission of the managers, in the theatre of the Royal Institution, 21, Albemarle Street, W.

Admission will be by ticket only. Full particulars will be given in the next number of the Proceedings.

At the next Ordinary Meeting, on **Wednesday,** March **16**th, 1904, at **5.30.** p.m., the following papers will be communicated:—

"Mercuric nitrite and its decomposition by heat." By P. C. Rây.

"Note on the higher glycerides." By J. B. Hannay.

"The nature of a solution of iodine in aqueous potassium iodide." By C. H. Burgess and D. L. Chapman.

"The reduction of 2:6-dinitrotoluene with hydrogen sulphide." By J. B. Cohen and J. Marshall.

"Isomeric change of diacylanilides into acylaminoketones. Transformation of the dibenzoyltoluidines into the isomeric benzoylaminomethylbenzophenones." By F. D. Chattaway and W. H. Lewis.

"Acid esters of methyl substituted succinic acids." By W. A. Bone, J. J. Sudborough, and C. H. G. Sprankling.

"The action of ethyl β-iodopropionate on ethyl disodioacetylenetetracarboxylate." By O. Silberrad.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 278.

Wednesday, March 16th, 1904. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. L. F. Guttmann, J. H. Pollok, F. D'O. Mears, and M. Blood were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Harold S. Hammond, Government Laboratory, Kingston, Jamaica.
Laurel Cecil F. Oldfield, Lincoln College, Oxford.
William D. Page, Constitutional Club, London, W.C.
Thomas L. D. Porter, B.Sc., 161, Downsell Road, Stratford, E.
Louis John E. Riley, Port-of-Spain, Trinidad.
Henry Heron Smith, 76, Plumstead Common Road, Plumstead.

Of the following papers, those marked * were read:

*46. "Mercuric nitrite and its decomposition by heat." By Prafulla Chandra Râ̂y.

Mercuric nitrite, hitherto unknown, can be obtained by evaporating *in vacuo* over sulphuric acid the solution left by decomposing mercuric chloride with silver nitrite. It occurs in groups of light yellow needles which slowly deliquesce and decompose when exposed to the air. The salt and its aqueous solution are stable when sealed up out of contact with air. The solid salt is largely decomposed by water. When heated at about 100° in a vacuum, it melts and intumesces, decomposing for the most part into mercurous nitrate and nitric oxide, but also, to a small extent, into red, crystalline mercuric oxide and the gases of decomposed nitrous anhydride. Mercurous nitrate is also the main product of the decomposition of mercurous nitrite at about 200°, but in this case the nitrate occurs principally as a pseudo-sublimate, derived from the vapours of the decomposing nitrite (*Proc.*, 1903, **19**, 78; *Trans.*, 1903, **83**, 491).

DISCUSSION.

Dr. DIVERS said that, in order to understand the production of mercurous nitrate and nitric oxide from mercuric nitrite, it was necessary (1) to bear in mind that nitric peroxide acts freely on metallic silver to form nitrate and nitric oxide, and has no action whatever on silver nitrite, and that silver nitrate heated with nitric oxide, even at temperatures well below 200°, interacts with it to form nitrite and nitric peroxide; (2) to assume the same to be true of mercurous nitrite and nitrate; and (3) to refer to the decomposition by heat of mercurous and silver nitrites. Silver nitrite, heated only moderately, behaves almost like mercuric nitrite, except that half the silver is left in the metallic state. But when it is decomposed rapidly, the silver nitrate produced is small in quantity, most of the silver being left in the metallic state and much nitric peroxide escaping. When mercurous nitrite is heated, the ultimate products are also mercurous nitrate and nitric oxide, together with about half of the metal in the free state. But here, visibly, the first products are, for the most part at least, metal and nitric peroxide, which then, at some distance off, interact to form mercurous nitrate and nitric oxide. It can, therefore, hardly be doubted that the products of decomposition of two molecules of mercuric nitrite by heat are represented by $2Hg + 4NO_2$, which then become $(HgNO_3)_2 + 2NO$, without much loss by vaporisation at the relatively low temperature at which the salt decomposes.

*47. "Note on the higher glycerides." By James Ballantyne Hannay.

The higher glycerides, as represented by purified stearin, olive oil, linseed oil, castor oil, cotton-seed oil, rape oil, and earth-nut oil, are all capable of entering into direct combination with lead oxide, the new compounds being formed by heating the oils with excess of finely-divided litharge at 170° to 180° and dissolving out the product with chloroform, petroleum, or carbon tetrachloride. The substance obtained resembles wax and has no sharp melting point; it begins to soften at 120°, becomes viscous at 150° to 160°, and is quite limpid at 190°. It commences to boil and decompose at about 280°, the temperature varying a few degrees according to the oil used.

In the case of the olein derivative, the composition may be represented by the formula $C_3H_5O_3{:}Pb_3(C_{18}H_{23}O_2)_3$, where the three atoms of lead are seen to replace six atoms of hydrogen, three in molecules of glycerol, and three in those of oleic acid. This compound probably represents the first step in saponification by lead oxide. The oleic acid derivative, when dissolved in ether, is decomposed by cold water in the following manner:

$$2(C_{57}H_{104}O_6,3PbO) + 3H_2O = 2(C_3H_8O_3) + 3(C_{18}H_{33}O_2)_2Pb,PbO,$$

glycerol and a basic lead oleate being thereby produced. Lead glyceryl oleate and the corresponding stearate, linoleate, and ricinoleate resemble mercury thymyl acetate in forming a double compound with lead acetate.

The foregoing compounds are stable and not affected by fractional precipitation, neither is the lead displaced by metallic sodium, phosphoric oxide, or sulphur trioxide. The free linkings of the unsaturated glycerides were unaffected by the combination with lead oxide, for the iodine number remained unchanged.

The combination of the lead glyceryl oleate with sulphur chloride is similar to the products obtained from the unsaturated glycerides in general. An examination of the action of sulphur chloride on oils showed that with due precaution the sulphur chloride additive compound was identical in type with the substances obtained by the addition of bromine, iodine, and oxygen. The sulphur chloride saturated the free linking, thus behaving as a bivalent radicle. The oxygen absorption was determined for the same oils, and the results of all these combinations have been tabulated.

During these investigations, no evidence has been obtained of the existence of Hazura's linolenic or *iso*linolenic acid with six free linkings (with eighteen in the triglyceride); all the iodine numbers are well under the limit for pure linoleic acid with four free linkings, this deficiency being due to the presence of oleic or other acid of a more saturated type.

Experiments were made with numerous samples from which the acid had been obtained by three different methods, but only linoleic acid with four linkings was obtained, this result agreeing with that of

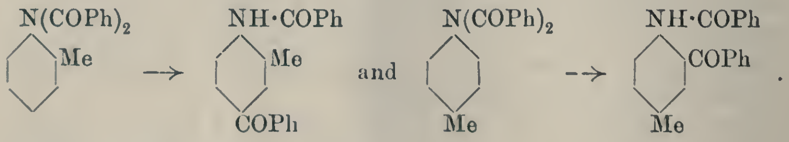
Reformatzky, who could find no evidence of the existence of acids with six free linkings.

The author showed that Hazura's method of separation with alkaline permanganate has a very variable effect, the oxidation proceeding further than the formation of hydroxy-acids. Hence it is concluded that no acid with an iodine number higher than that corresponding with four free linkings exists in natural oil.

*48. "Isomeric change of diacylanilides into acylaminoketones. Transformation of the dibenzoyltoluidines into the isomeric benzoylaminomethylbenzophenones." By Frederick Daniel Chattaway and William Henry Lewis.

It has been shown recently that acyl groups must be included among those which, under suitable conditions, can pass from the nitrogen of an aromatic amine into the nucleus, displacing a hydrogen atom in a para- or ortho-position relatively to the nitrogen.

An excellent illustration of this intramolecular rearrangement is furnished by the behaviour of the dibenzoyltoluidines, which at a high temperature under the influence of hydrogen chloride are converted into the isomeric benzoylaminomethylbenzophenones, thus:



In the transformation of dibenzoyl-*o*-toluidine, when the acyl group might take up a para- or an ortho-position relatively to the nitrogen, the former is assumed, apparently exclusively. In the transformation of dibenzoyl-*p*-toluidine, an ortho-position only is available.

As in the case of the analogous transformation of the acylchloroamines, interchange between the *p*-hydrogen atom and the acyl group takes place more readily than that in which the hydrogens in the ortho-positions are concerned.

The yield of 4-*amino*-5-*methylbenzophenone* is about 50 per cent. and that of 2-*amino*-5-*methylbenzophenone* about 20 per cent. calculated on the weight of the corresponding toluidine used.

These hitherto unknown aminoketones were described together with a number of their more important derivatives.

*49. "The action of ethyl β-iodopropionate on ethyl disodioethanetetracarboxylate." By Oswald Silberrad.

The investigation of the interaction between ethyl β-iodopropionate and ethyl disodioethanetetracarboxylate has led to the discovery of the following new compounds:

Ethyl butane-αγγδδ-pentacarboxylate,

$$CO_2(C_2H_5)\cdot CH_2\cdot CH_2\cdot C(CO_2\cdot C_2H_5)_2\cdot CH(CO_2\cdot C_2H_5)_2,$$

boils at 215—218° under 17 mm. pressure and yields haloid derivatives which readily give rise to a lactonic acid.

Butane-αγγδδ-pentacarboxylic acid,

$$CO_2H\cdot CH_2\cdot CH_2\cdot C(CO_2H)_2\cdot CH(CO_2H)_2,$$

readily loses carbon dioxide, forming butane-αγδ-tricarboxylic acid, which melts at 122°, and not at 116—120° as previously given (Auvers, Köbner, and Megenburg, *Ber.*, 1891, **24**, 2895).

Ethyl Δ^{β}-dihydromuconate (Δ -butylenedicarboxylate),

$$CO_2(C_2H_5)\cdot CH_2\cdot CH{:}CH\cdot CH_2\cdot CO_2\cdot C_2H_5,$$

boils at 120—125° under 17 mm. pressure. The formation of this substance, which constitutes one of the minor fractions, is probably due to the condensation of two molecules of ethyl β-iodopropionate with loss of hydriodic acid.

Hexane-αγγδδζ-hexacarboxylic acid was obtained by the saponification of the corresponding ester, which, however, was not isolated in a pure condition; the constitution of the acid was established by its conversion, with loss of carbon dioxide, into hexane-αγδζ-tetracarboxylic acid, which latter appears to be identical with Sell and Easterfield's *αα*-diglutaric acid.

Ethyl ethylenetetracarboxylate, $(CO_2\cdot C_2H_5)_2C{:}C(CO_2\cdot C_2H_5)_2$, is also produced in small quantities, and was identified by conversion into its acid potassium salt. Its formation is probably due to the action of iodine, produced by the decomposition of ethyl β-iodopropionate, on ethyl disodioethanetetracarboxylate.

*50. "The heat of formation of glucinum chloride." By James Holms Pollok.

This research was undertaken in order to obtain the heat of formation of glucinum chloride direct from the metal, for this constant is required in calculating the heats of formation of the other salts of glucinum from the heats of neutralisation of the various acids by the base glucina.

A sample of ground beryl from Limoges was employed in the preparation of pure glucina, and this oxide was converted into the anhydrous chloride by heating with carbon (from cane sugar) in a current of dry chlorine, the metal being finally obtained from the salt by the action of metallic sodium in a nickel crucible.

On dissolving the metal in hydrochloric acid contained in a calorimeter, it was found that the heat of formation of glucinum chloride in solution was 199·5 calories. The heat of solution of the anhydrous chloride in water is 44·5 calories, and deducting this from the foregoing number, the heat of formation of dry anhydrous glucinum chloride is found to be 155 calories.

*51. "A note on the composition of distilled oil of limes and a new sesquiterpene." By Herbert Edward Burgess and Theodore Henry Page.

The authors have isolated and identified *l*-terpineol (m. p. 35°) as forming a large proportion of the oxygenated constituents of the oil. The peculiar odour of the oil which is attached to the terpineol fraction is due to an isomeric liquid terpineol of slightly lower boiling point. A new sesquiterpene of partially olefinic nature was also identified, which boils at 131°/9 mm. and at 262—263° (uncorr.)/756 mm., in the latter case, with slight decomposition; it has a sp. gr. 0·873 at 15° and is optically inactive; n_D is 1·4935 at 15°, and 1·4910 at 19·5°. The sesquiterpene, for which the name "*limene*" is proposed, was characterised by the formation of a trihydrochloride (m. p. 79—80°); this was the only well-defined derivative obtained, and from it the hydrocarbon can be readily regenerated. The same sesquiterpene has been identified in hand-pressed lime oil and lemon oil, and the other oils of this series are being examined for it.

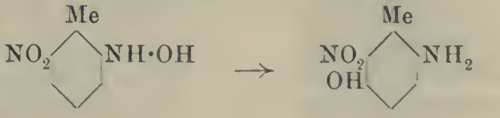
52. "The nature of a solution of iodine in aqueous potassium iodide." By Charles Hutchins Burgess and David Leonard Chapman.

Jakowkin (*Zeit. physikal. Chem.*, 1894, **13**, 529; 1896, **20**, 14) has shown that the distribution of iodine between carbon disulphide and an aqueous solution of potassium iodide of varying concentration accords with the assumption of a dissociable compound KI_3. Dawson's observations (Trans., 1901, **79**, 238), conducted at a different temperature, confirm this conclusion. The work of the authors has been directed towards the measurement of the relative velocities of the $\bar{I}$- and $\bar{I}_3$-ions by two independent methods; firstly, by a careful comparison of the iodine carried over to the anode by the same current in cells containing respectively aqueous potassium iodide and a solution of iodine in aqueous potassium iodide, and, secondly, by a comparison of the conductivities of the same solutions. The mean values of the relative velocities of the $\overline{I}_3$- and $\overline{I}$-ions, determined by the first and second methods, are 0·556 and 0·553 respectively. These practically identical results, obtained by two different processes, are regarded as confirming the conclusions of previous observers.

A new and symmetrical method of writing the equilibrium equations of the foregoing solution was suggested.

53. "The reduction of 2 : 6-dinitrotoluene with hydrogen sulphide." By Julius Berend Cohen and Joseph Marshall.

In the course of an experiment in which 2 : 6-dinitrotoluene was reduced with hydrogen sulphide in alcoholic ammonia, a quantity of 2-nitro-4-amino-*m*-cresol was obtained together with 6-nitro-*o*-toluidine. The nitroaminocresol crystallises in dark orange needles, which dissolve readily in dilute acids and alkalis, and melt at 190° with decomposition; it forms colourless salts with the mineral acids and is precipitated from its solution in alkalis by carbon dioxide. On oxidation with lead peroxide and dilute sulphuric acid, it yields 2-nitrotoluquinone, which crystallises in ruby-red prisms melting at 64—65°, and is converted into 2-nitrotoluquinol by reduction with sulphur dioxide; the latter crystallises in scarlet needles melting at 117—118° and dissolving in aqueous alkalis to a violet solution. A solution of bleaching powder in the presence of hydrochloric acid converts nitroaminocresol into chloronitrotoluquinone, which crystallises in pale yellow, spear-shaped crystals melting at 70—71°. The nitroaminocresol is formed by the incomplete reduction of 2 : 6-dinitrotoluene to 6-nitro-*o*-tolylhydroxylamine in the same way that trinitrobenzene and trinitrotoluene are converted into the hydroxylamino-compounds (Cohen and Dakin, Trans., 1902, 81, 26). The hydroxylamine derivative, on boiling with dilute hydrochloric acid, changes into the corresponding *p*-aminocresol:



54. "Acid esters of methylsuccinic acids." By William Arthur Bone, John Joseph Sudborough, and Charles Henry Graham Sprankling.

The methyl hydrogen salts of succinic, *cis*- and *trans-s*-dimethylsuccinic, and tetramethylsuccinic acids have been obtained by the addition of methyl alcohol to the corresponding anhydrides; they melt respectively at 58°, 38°, 49° and 63°.

The methyl hydrogen salts of the unsymmetrical monomethylsuccinic, *gem*-dimethylsuccinic, and trimethylsuccinic acids have been prepared by three distinct methods: (*a*) from the anhydride, (*b*) from the neutral ester, and (*c*) from the acid. The oily products obtained by all three methods from methylsuccinic acid, give practically the same dissociation and esterification constants.

From *gem*-dimethylsuccinic acid, two distinct acid methyl esters have been obtained; one of these melts at 52° and has a lower dissociation, and also a lower esterification constant than its isomeride, which melts at 40·5°.

The methyl hydrogen salts obtained from trimethylsuccinic acid are oils, the esters obtained from the anhydride and from the acid appear to be identical, but differ from the oil obtained from the neutral ester as regards their dissociation and esterification constants. The results obtained indicate that there is no direct relationship between the two sets of constants.

The esterification constant tends to decrease with an increase in the number of methyl groups present. Walker's generalisation with respect to the dissociation constants does not hold good, as in the succinic series the ratio $\frac{K\text{ acid}}{K\text{ acid ester}}$ increases from 2·12 for succinic acid to 27·0 for tetramethylsuccinic acid. The value for a in Wegscheider's equation, $aK = Ka + K\beta$, gradually decreases from 0·945 for succinic acid to 0·074 for tetramethylsuccinic acid.

55. "A note on phenyldimethylallylammonium compounds." By Alfred William Harvey.

Before the publication of a paper by H. O. Jones (*Trans.*, 1903, **83**, 1400), the author had attempted to resolve phenyldimethylallylammonium compounds into active constituents. His results, although differing in important details, confirm the conclusions deduced by Barrowcliff and Kipping (*Trans.*, 1903, **83**, 1141) and by Jones (*loc. cit.*).

56. "Estimation of hydrogen peroxide in the presence of potassium persulphate, by means of potassium permanganate." By John Albert Newton Friend.

A correct estimate of the amount of hydrogen peroxide present in a mixture of that substance and potassium persulphate solution is not given under ordinary conditions by titration with potassium permanganate, the values obtained being always too low.

It is found that the proportion of permanganate required to decompose the hydrogen peroxide is subject to the following variations: (1) it increases with the speed of titration, (2) it varies inversely with the the concentration of the persulphate and the volume of the titrated solution, (3) it increases and finally reaches the theoretical amount when the concentration of the sulphuric acid is increased.

A fairly accurate estimation may therefore be obtained if the time of titration is short and the volume titrated is small, whilst the concentration of the sulphuric acid is fairly great.

57. "A comparison of the products of the hydrolysis of potato starch with those obtained from cereal starches." By James O'Sullivan.

In this investigation, it was established by six series of hydrolytic experiments on potato, Lintner's, malt, barley, maize, and rice starches, with both malt-extract and diastase, that the products of the hydrolysis of potato starch, as regards the percentages of maltose and dextrin, bear no quantitative relationship to those yielded by the other starches, and that therefore the products of the hydrolysis of the other starches could not be inferred from the hydrolysis of potato starch.

March 23rd, 1904. Annual General Meeting. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Dr. G. Barger and Dr. S. B. Schryver were appointed scrutators, and the ballot was opened for the election of Officers and Council for the ensuing year. The President then presented the following Report on the state of the Society during the past twelve months:

REPORT OF THE COUNCIL.

THE Council are in the fortunate position of being able to report that the Society continues to increase and flourish. At the date of the Annual General Meeting last year, the number of Fellows was 2,631 * ; since that date, 170 Fellows have been elected and three reinstated, making a gross total of 2,804. Of these, 23 have been removed for non-payment of subscriptions, and the elections of 2 have become void, 28 have resigned, and 17 have died, leaving a net total of 2,734 Fellows on our list.

The names of the Fellows who have died are :

H. G. Adshead.
J. O. Alexander.
A. E. Barrows.
Baron de Bush.
Samuel Clift.
W. H. Corfield.
T. H. Dodd.
T. W. Fletcher.
W. Francis.
H. B. Fulton.
A. G. Hendry.
T. Isherwood.
C. James.
T. A. Lawson.
J. Mactear.
J. Reddrop.
G. H. Robertson.

The following Fellows have withdrawn :

W. H. Barlow.
W. M. Brothers.
R. J. Brown.
A. Collenette.
W. Diamond.
J. R. Don.
D. Ferrier.
A. E. Garrod.
W. Goodall.
W. Grafton.
A. Hill.
T. Lemmey.
W. Lewins.
H. Macan.
A. M. Martin.
J. A. Mathews.
J. Morison.
A. A. Ramsay.
J. Robson.
W. Round.
W. J. C. Scrutton.
G. A. Shaw.
E. A. Smith.
G. C. Thomson.
A. L. Thornton.
G. A. Waterhouse.
W. J. Williams.
A. W. Winterton.

As in future Reports the accounts and other statistics of the Society will be given for the calendar year, the following data for the year 1903 may be of interest for purposes of comparison. The number of Fellows on January 1st, 1903, was 2,607, and during the year 173 Fellows have been elected and 5 reinstated by the Council, making a gross total of 2,785. Of these, the Society has lost 16 by death, 46 from resignations, and 23 by removal for non-payment of subscriptions, giving the number of Fellows in the Society on December 31st, 1903, as 2,700.

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* Last year this number was incorrectly stated to be 2471 (*Proc.*, 1903, **19**, 81 ; *Trans.*, 1903, **83**, 629).

The Society has to lament the death of a distinguished Foreign Fellow, Professor Wladimir Markownikoff, on February 11th, 1904.

The small number of Fellows elected in the early days of the Society has been further reduced by the death of Dr. William Francis.

The scientific work of the Society during the past session gives evidence of continued activity. Since the last Annual General Meeting, 163 scientific communications have been made to the Society, 107 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

During 1903, 181 scientific communications were made to the Society, 110 of which were published in the *Transactions* for that year, abstracts of all appearing in the *Proceedings* for 1903.

The volume of *Transactions* for 1903 contains 142 memoirs occupying 1,490 pages, whilst that for the preceding year contains 160 memoirs occupying 1,604 pages.

The *Journal* for 1903 contains also 3,882 abstracts which may be classified as follows:—

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	872	1650

Part II.

	Pages.	No. of Abstracts.
General and Physical Chemistry		471
Inorganic Chemistry		443
Mineralogical Chemistry		119
Physiological Chemistry		391
Chemistry of Vegetable Physiology and Agriculture		242
Analytical Chemistry		566
	768	2232
Total in Parts I. and II.	1640	3882

In April last, Professor Emil Fischer was invited to give the Faraday Lecture in the autumn, and provisional arrangements were made for its delivery early in the present session. Much to the regret of the Council, continued ill-health has prevented Professor Fischer from fulfilling his intention, and for the present the hope of numbering him among the Faraday Lecturers has had to be abandoned. The Council are glad to be able to announce that Professor Ostwald will deliver the Faraday Lecture on Tuesday, April 19th, in the Lecture Theatre of the Royal Institution, kindly lent by the Managers for the occasion.

The Centenary of the Enunciation of the Atomic Theory by Dalton was celebrated by the Literary and Philosophical Society of Manchester in May last, and in company with Sir Henry Roscoe, Professor Thorpe, and Professor Frankland, Vice-Presidents, Dr. Scott, Secretary, and Sir William Ramsay, Foreign Secretary, the President attended the meeting, and presented an address in the name of the Chemical Society.

The triennial award of the Longstaff Medal to the Fellow of the Society who, in the opinion of the Council, has done the most to promote chemical science by research in the interval since the last presentation, was made, on the recommendation of the Research Fund Committee, to Professor W. J. Pope, F.R.S., for his researches on the stereochemistry of compounds of elements other than carbon.

The Fifth International Congress of Applied Chemistry was held in Berlin in June last, and the President attended as the representative of the Society. An invitation to the Congress to hold its next meeting in London, given by the President of the Society of Chemical Industry, was supported by the President, but on a vote being taken Rome was chosen as the place of the meeting in 1905.

The Council welcomed the opportunity of sending a letter of congratulation to their distinguished Foreign Fellow, Professor Mendeléeff, on the occasion of his seventieth birthday, which occurred on February 9th last.

The increase in the use of the Library mentioned in last year's report has been maintained, as 975 books were borrowed from the Library, as against 925 during the previous year. The additions to the Library comprise 115 books, of which 49 were presented, 268 volumes of periodicals, and 48 pamphlets; as against 84 books, 338 volumes of periodicals, and 23 pamphlets last year. The corresponding numbers for the year ending December 31st, 1903, are 991 books borrowed, the additions to the Library being 126 books, of which 51 were presented, 271 volumes of periodicals, and 43 pamphlets.

The changes proposed in last year's report with regard to the Library have now been carried out, and cases have been erected in one of the rooms in the basement for the storage of the less used books. These cases will accommodate about 3,500 volumes, and so provide room for the growth of the Library for about seven years. An equal number of cases can be added at any future period without cost beyond that of the cases themselves.

Mr. F. W. Clifford was appointed Librarian on July 1st.

The Council regret to have to record the death, on May 10th, of Mr. Josiah Hall, who for twenty-five years had been Collector to the

Society, and who retired in 1895 with a pension of £130 a year. It was decided to grant to Mrs. Hall, his widow, an annuity of £30.

The Society has been the fortunate recipient of two handsome busts in bronze of distinguished chemists, that of Liebig (a copy of the one in Munich) having been presented by Dr. Messel, and that of Dalton, which has been modelled from all available sources by Miss Levick, by Professor Thorpe. Two interesting photographs of portraits have also been received, one of Roger Bacon, presented by Mr. Oscar Guttmann, and one of Dr. Wm. Prout, F.R.S., from his son, the Rev. T. J. Prout.

At an Extraordinary General Meeting of the Society held on July 2nd, the proposal of the Council to alter Bye-Law I. so that the annual publications of the Society should not be sent to Fellows who are in arrear with their subscriptions was unanimously approved. To give effect to this change in the Bye-Law, the *Journal* is now issued to Fellows on the last day instead of the first day of the month. An extra number of the *Transactions* was issued on December 31st to provide for the publication of papers which would have appeared on January 1st, 1904, under the old arrangement, and now that the change has been made the net result is that Fellows receive the monthly parts of the *Journal* a day earlier than heretofore.

The first part (Authors' Index) of the Collective Index for the decade 1893—1902, promised provisionally for 1904, was issued in January to those Fellows who had made application for it in accordance with the printed notices circulated with the monthly parts of the *Journal* since last July, and it is hoped that the subject index for the same period may be ready before the end of next year. The rapid publication of the Authors' Index is due to the untiring energy and devotion of the Indexer, Mrs. Dougal, and has in no way interfered with the issue of the Annual Index at the end of February, which has been customary since she undertook the work involved in its preparation.

The Second Report of the Joint International Committee on Atomic Weights, which now includes Professor Moissan as the representative of France, with its revised table of atomic weights, has been issued to Fellows both in the *Proceedings* and in the *Journal*.

The Council resolved that the rooms of the Society should be closed not later than 10.30 p.m. on those evenings on which meetings are held, and, as very few Fellows were found to use the Library on Saturday afternoons, it was further resolved that it should be closed at 2 p.m. on Saturdays from the beginning of the present year.

Grants amounting in all to £232 have been made during the year from the Research Fund, of which amount £15 has been returned.

The Council desires to record its deep sense of obligation to Dr. Horace T. Brown for the ability and patience with which he has discharged the duties of Treasurer during the past year. Finding on taking office that a complete reorganisation of the method of collecting the contributions of Fellows and of keeping the Accounts of the Society was immediately necessary, he did not shrink from the immense labour involved in establishing a new system and getting it into operation. The nature of the changes which have been made is explained below, and it is obvious that great sacrifices of time and of personal effort were involved in the process. It is, therefore, with the utmost regret that the Council has received from Dr. Brown an intimation that his engagements no longer permit him to retain office.

In March last it was found that certain subscriptions and admission fees of Fellows which had apparently been paid had not been entered in the Books of the Society. An examination of the Books was made by a firm of Chartered Accountants, and on April 22nd, the late Assistant Secretary, who at that time was acting as Librarian and Curator, was dismissed.

The Accountants subsequently reported that an investigation of the Society's Books, carried back to March, 1895, showed that there was an apparent deficiency amounting to £2306.

The late Assistant Secretary, whilst not admitting the accuracy of the amount of the deficiency, has, up to the present, repaid to the Society sums amounting to £250.

Hitherto, it has been customary for the Treasurer to close the Books of the Society a few days before the Annual General Meeting, and to make up the Accounts to a date as near to that of the Annual Meeting as possible. This arrangement has given rise to considerable inconvenience, owing in the first place to the short time allowed to complete the financial statements, and secondly to the impossibility of conforming strictly to that portion of Bye-Law VIII, which requires the Auditors to report to the Council at least one week before the Annual General Meeting. In future, therefore, the Treasurer will present his Accounts at the Annual Meeting made up to December 31st, instead of to some indeterminate day near the end of March, and these Accounts will be drawn up in a somewhat different form from that previously adopted. A statement of the financial condition of the Society made up for the year ending December 31st last in this modified form accompanies this Report, including a Revenue and Expenditure Account and Balance Sheet, but the Treasurer has considered it advisable on this occasion to include for purposes of comparison another statement made out on exactly the old lines up to March 12th, and it is to this latter statement, which is comparable with the one of last year, that the following remarks apply.

The total income of the Society, from March 22nd, 1903, to March 12th. 1904, was £7276 16*s.* 5*d.*, whilst the expenditure for the same period was £6060 17*s.* 4*d.*, showing an excess of income over expenditure of £1215 19*s.* 1*d.*, against a surplus last year of £817 7*s.* 1*d.* The comparison, however, is not a fair one, unless we adjust the figures in the respective years for the arrears of contributions in each case.

Owing to the alteration in July last of Bye-Law I, by which Fellows who are in arrear with their subscriptions do not receive the publications of the Society, the annual contributions, which become due in January, have been paid up more punctually this year than usual. On March 22nd, 1903, the arrears amounted to £2316, whilst on March 12th this year they were £2008, a difference in favour of this year of £308. When this adjustment is made, the surplus of this year becomes £907 19*s.* 1*d.* against £817 7*s.* 1*d.* last year, a result which may be regarded as highly satisfactory when we take into consideration certain large items of extraordinary expenditure which have been incurred this year, and which will be alluded to later.

The total amount received this year for Admission Fees, Life Compositions, and Subscriptions is £5809 against £4776 last year, a difference in favour of this year of £1033. This, however, includes £250 received on Account of Arrears of Subscriptions from the late Assistant Secretary, and, as already stated, the subscriptions this year are paid up more closely by £308. With these adjustments, the increased income this year from contributions of Fellows is £475, about half of which is due to the unusually large number of Life Composition Fees.

The sale of the Society's publications, and the proceeds of the advertisements in the Journal have brought in £40 9*s.* 4*d.* more than last year.

With regard to investments, the Treasurer has to report that since the last General Meeting he has, with the authority of the Council, purchased on behalf on the Society £1500 of Transvaal 3 per cent. Guaranteed Stock. The investments on the General Account now stand at £18,909 0*s.* 5*d.*, whilst those of the Research Fund Account are valued at £6659 5*s.* 5*d.*

The total expenditure this year shows the large increase of £665 19*s.* 4*d.*, which is due to certain large items of an exceptional nature.

The balance of the cost of the first volume of the Decennial Index, 1893—1902, amounting to £386 9*s.* 7*d.*, is chargeable against this year's revenue, being an increase of £254 5*s.* 3*d.* The completion of the Library Catalogue was announced in the Report of last year, but the main cost of £156 16*s.* 0*d.* has been borne by the present accounts.

The additional accommodation for books referred to in an earlier part of this Report has been provided at a cost of £128 2*s.* 4*d.* Two other large items of expenditure of an exceptional nature amounting to £228 1*s.* 6*d.* are included under Accountants' and Legal charges, and are mainly attributable to the special investigation of the Society's Accounts to 1895, to which reference has already been made above.

It is satisfactory to notice that the expenses incidental to the publication of the *Journal* show a decrease this year of about £100.

The system of keeping the Treasurer's accounts has undergone revision during the past year, the old system having been found insufficient for the present needs of the Society.

At the request of the Council, Messrs. W. B. Keen and Co., Chartered Accountants, have opened up a new set of books, and have also undertaken to give the Treasurer a quarterly audit, and to assist in the preparation of the accounts for the Annual Statement.

This arrangement, which guarantees skilled professional assistance and a thorough checking of the accounts at frequent intervals, has now been in operation for some time, and will not entail any additional expense to the Society, as the appointment of a Treasurer's Assistant is thereby rendered unnecessary.

Arrangements have been made with Messrs. Coutts and Co., the Society's Bankers, by which in future they will receive the contributions of Fellows direct.

Professor H. B. DIXON moved the adoption of the report, which was seconded by Mr. E. W. VOELCKER and carried unanimously.

Dr. SCOTT proposed, and Dr. PHILIP seconded, a vote of thanks to the Auditors, which was acknowleged by Dr. MOODY.

The PRESIDENT then delivered his address, which was devoted chiefly to a review of the scientific history of the Society since its foundation in 1841. The early volumes of the Memoirs of the Society contain papers by many eminent foreign chemists, such as that on "The Atomic Weight of Carbon," by Professors Redtenbacher and Liebig, and the memoir on "The Radical of the Cacodyl Series," by Professor Bunsen. These and others, such as Frankland's paper on "The Isolation of the Organic Radicals," indicate the general nature of the problems which occupied chemists in the early days of the Society. The *Quarterly Journal*, which, in 1849, succeeded the three volumes of Memoirs, contain many contributions by Hofmann, Williamson, Frankland, Kolbe, and Odling, but as it was the custom in those days for authors to send all their more serious work to the Royal Society, the *Journal of the Chemical Society* does not provide a continuous picture of the results of chemical investigation in this country. In 1862, the *Quarterly*

Journal was replaced by a monthly issue, and in 1863 a new series was commenced.

At that period, language and formulæ were alike governed by the then predominant theory of types. Modern views of constitution based on clearer ideas of valency were not definitely exhibited in the *Journal* till 1865, when Dr. Crum Brown's paper appeared on "The Theory of Isomeric Compounds." The change could, however, be accomplished only after agreement had been arrived at in reference to atomic weights. Stereochemical ideas, inaugurated in 1875 by Le Bel and van't Hoff, have reached their logical conclusion in the work of Pope.

Other subjects traced through the successive volumes of the *Journal* are the spectroscope, the periodic scheme of classification, molecular weights, and the application of Avogadro's law. The paucity of systematic research in the United Kingdom during so many years was referred to, and some of the causes which led to the publication of so few papers by the Society, and the rapid development of activity during the last twenty years.

The address concluded with a suggestion for the publication by the Society of annual reports on the progress of chemistry in its several more important divisions.

Professor EMERSON REYNOLDS proposed a vote of thanks to the President, coupled with a request that he would allow his address to be printed in the *Transactions*.

Mr. DAVID HOWARD seconded the motion, which was carried by acclamation and acknowleged by the PRESIDENT.

Professor DIVERS proposed a vote of thanks to the Treasurer, Secretaries, and Council. This was seconded by Mr. SPILLER and unanimously adopted. Dr. SCOTT responded.

The Scrutators presented their report to the President, who declared the following to have been duly elected as Officers and Council for the ensuing year:

President: W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S,; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents : Horace T. Brown, LL.D., F.R.S. ; Harold B. Dixon, M.A., F.R.S. ; Wyndham R. Dunstan, M.A., F.R.S. ; P. F. Frankland, LL.D., F.R.S. ; David Howard ; Raphael Meldola, F.R.S.

Secretaries : W. P. Wynne, D.Sc., F.R.S. ; M. O. Forster, D.Sc., Ph.D.

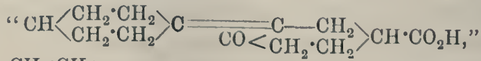
Foreign Secretary : Sir W. Ramsay, K.C.B., LL.D., F.R.S.

Treasurer : Alexander Scott, M.A., D.Sc., F.R.S.

Other Members of Council : Augustus E. Dixon, M.D. ; J. J. Dobbie, M.A., D.Sc. ; Bernard Dyer, D.Sc. ; Alfred D. Hall, M.A. ; A. Harden, D.Sc., Ph.D. ; J. T. Hewitt, M.A., D.Sc. ; C. A. Kohn, Ph.D., B.Sc. ; A. Lapworth, D.Sc. ; J. E. Marsh, M.A. ; E. J. Mills, D.Sc., F.R.S. ; S. Ruhemann, M.A., Ph.D. ; J. M. Thomson, LL.D., F.R.S.

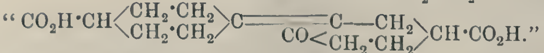
ERRATA.

Proc., 1904, Vol. 20.

P. 51, line 22, *for* "

$$CH\left<\begin{matrix}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{matrix}\right>C{=\!=\!=}\begin{matrix}C{-}CH_2\\CO<CH_2\cdot CH_2\end{matrix}\!\!>CH\cdot CO_2H,$$

" *read*

"

$$CO_2H\cdot CH\left<\begin{matrix}CH_2\cdot CH_2\\CH_2\cdot CH_2\end{matrix}\right>C{=\!=\!=}\begin{matrix}C{-}CH_2\\CO<CH_2\cdot CH_2\end{matrix}\!\!>CH\cdot CO_2H.$$

"

P. 51, line 2*, for "*α-hydroxyhexahydroterephthalic acid,*" read "cis-*α-hydroxyhexahydroterephthalic acid.*"

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* From bottom.

THE FARADAY LECTURE.

The Faraday Lecture will be delivered by Professor W. Ostwald on **Tuesday, April 19th, 1904, at 8.30 p.m.**

Professor Ostwald will lecture in English, the subject of his discourse being "Elements and Compounds."

The Lecture will be delivered, by the kind permission of the Managers, in the **Theatre of the Royal Institution, 21, Albemarle Street, W.**

Admission will be by ticket only. Each Fellow of the Society is entitled to two tickets, which may be obtained on application to the Assistant Secretary, Chemical Society, Burlington House, W.

At the next Ordinary Meeting, on **Wednesday, April 20th, 1904, at 5.30 p.m.**, the following papers will be communicated.

"The vapour density of hydrazine hydrate." By Alexander Scott.

"The combining volumes of carbon monoxide and oxygen." By Alexander Scott.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C. AND BUNGAY, SUFFOLK.

Issued 30/4/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 279.

April 19th, 1904. Extra Meeting, Professor W. A. TILDEN, D.Sc. F.R.S., President, in the Chair. This meeting was held in the Theatre of the Royal Institution, by kind permission of the Managers.

The PRESIDENT, in opening the proceedings, said:—So many years have elapsed since we enjoyed the delivery of a Faraday Lecture that perhaps a few words of introduction may not be regarded as inopportune. Faraday died in 1867, and immediately after his decease the Council of the Chemical Society met together and determined that, if possible, they would do something permanently to do honour to his memory; and the result was that, after considerable deliberation, they decided to establish this system of lectures. The first of the course was given in 1869 by Dumas, only two years after Faraday's death. Dumas was succeeded by Cannizzaro, Hofmann, Wurtz, Helmholtz, Mendeléeff and Lord Rayleigh. You will see, therefore, that the most eminent men of science living at the time were ready to accept the invitation to undertake the office of Faraday Lecturer. Owing to accidental circumstances it is, however, a rather long period—some 23 years—since we heard the voice of a Faraday Lecturer. Thanks to the kindness of the Members and the Managers of the Royal Institution, the lectures have all, hitherto, been given within this place, the walls of which for so many years echoed to the voice of Faraday, and which were the witness of his teaching and his triumphs. The Council of the Chemical Society were naturally anxious on the present occasion, as on all previous occasions, to find a man who might safely be regarded as qualified by his own researches and by his own contributions to science, worthily to fill the office of Faraday Lecturer; and they are satisfied that they have found such a man among their own Honorary Members. Professor Ostwald is a man who is not only honoured in the country of his adoption, but is famous throughout the world as the apostle of the modern doctrines concerning chemical affinity and the mechanism of chemical action. I will not, however, occupy any further time, but ask Professor Ostwald to be good enough to give us his lecture.

Professor OSTWALD then delivered the Faraday Lecture, of which the following account is an abstract.

"Elements and compounds."

The most general concept underlying all chemical theory is that of a *phase* created by Willard Gibbs. A phase is a physical homogeneous body, which may be either chemically homogeneous or composed of any number of substances. Every single phase has two degrees of freedom, irrespective of its chemical simplicity or complexity. A difference arises only if a second phase is formed. When that happens, we have two different cases: either the properties of the remaining part of the first phase change during the transformation into a new phase, or they remain constant. Phases of the first order we call *solutions*; of the second, *hylotropic bodies*.

By forming a new phase of a solution, we get two portions possessing different properties. On separating these parts, and on repeating the separation into two phases, every solution finally splits up into a finite number of hylotropic bodies.

Generally, a hylotropic body behaves as such only within certain limits of temperature and pressure. Beyond these limits of stability, it assumes the properties of a solution, and can therefore be split up again into a finite number of other hylotropic bodies. These we call *simpler* bodies than the former. At last it becomes impossible to change the hylotropic body into a solution, because it is not found practicable to reach its limit of stability. *Substances which can form only hylotropic phases we call elements.*

With hylotropic substances, we can again distinguish two cases. (1) Either the hylotropic body can exist as such only at one definite temperature and pressure, and by changing these conditions the body is transformed into a solution. This is the case with solutions of constant boiling point (for example, the solution of acids investigated by Sir Henry Roscoe) or with cryohydrates, &c. (2) Or there is a finite range of temperatures and pressures within which the phase invariably behaves as a hylotropic body; in this case, we have a *substance* proper. A substance or chemical individual is therefore the limiting case of hylotropic solutions, and is defined experimentally by its not changing its properties if the phase is partially transformed into another, for example, by distillation or crystallisation. This is indeed the way in which pure substances are defined and identified practically.

The constancy of properties is causally connected with constancy of composition; that is, if it is possible to produce a substance proper from other substances or hylotropic bodies, the ratio of the weights of the component parts must have a certain value in order that this peculiar body of constant properties may be formed. This is the *law of constant proportions.*

In forming such peculiar bodies, elements and compounds behave alike, and there is, therefore, in every case a certain definite relation between a substance and its components, the last being compounds or elements. A compound substance can therefore be split up into, or regenerated from, elements only in one definite manner. If we form a ternary compound ABC of the elements A, B, and C, we get the same substance by forming first AB and uniting it with C, or by first preparing AC and combining this with B, or, lastly, in forming the compound ABC directly from the elements.

By combining A with B, we get a certain ratio of weights between the two elements, and also a ratio for C by combining it with AB to form ABC. Now, as the composition of ABC is independent of the manner of formation, the composition of a substance AC is not more arbitrary, but is already defined by the composition of ABC, for it must contain A and C in the same ratio as in ABC. In the same way, the composition of a substance BC is defined in such a manner that the elements A, B, C, can combine only in definite ratios, regulated by the combining weight of each element for the compound ABC. This is the *law of combining weights,* generally spoken of as the law of atomic weights.

From this law, the *law of multiple proportions* can be deduced easily by applying the same considerations to the case of two elements forming more than one compound.

All the stoichiometrical laws, which have hitherto been deduced and explained only by the atomic hypothesis, prove to be direct consequences of the purely empirical definition of the concept of a substance proper or a chemical individual, and the atomic hypothesis is rendered superfluous for the purpose of this deduction.

According to the energetic theory of the elements, these bodies are explained as being distinguishing points of maximum stability relative to all adjacent conceivable substances. If we assume that the two characteristics are sufficient to determine the nature of a substance, and it we put these characteristics in plane co-ordinates horizontally and erect vertical lines in every point of the plane to express the free energy of the corresponding substances, we get a continuous surface like the stalactitic ceiling of a cavern, the end of each stalactite representing an element. A drop of water hanging on the ceiling represents by its flow the possible changes between the elements. To bring the drop from one stalactite to another, it must be raised above the pass between the two stalactites. This requires a certain concentration of free energy, and the practical impossibility of changing one element into another is due to the practical impossibility of bringing about the required concentration of energy. Now, with radium and other unstable elements, energy is not a relative minimum compared with the adjacent possible substances, but only a change in the slope of the surface which represents it. The drop of water can flow of its own accord from the point of the element, and will only lessen its speed on passing through this point. As the drop arrives finally at the end of the stalactite of helium, which is very low indeed (because helium cannot even form compounds), the enormous development of energy connected with this transmutation is explained at once. From the general law, that the most stable point of a changing system is not reached directly, but only through all the possible stages of unstable forms of the system, the intermediate formation of new and transitory substances and of new and transitory forms of energy is also explained, again without any application of hypothetical atomic concepts.

In presenting the Faraday Medal to Professor Ostwald at the conclusion of the Lecture, the PRESIDENT said:—It is now my pleasant duty, Professor Ostwald, in the name of the Society, to offer for your acceptance this medal, which bears the image of Faraday, and which has been struck in commemoration of this occasion.

Professor DEWAR: You, Sir, have placed upon me the very onerous duty of expressing the grateful thanks of the members of the Chemical Society of London to Professor Ostwald for the magnificent way in which he has discharged the duties of Faraday Lecturer, and the honour he has done us in accepting that office. You, Sir, have pointed to the great galaxy of talent with which he must be associated for all time, in referring to the great names of those who in the past have occupied the position. Now I am quite sure that every chemist in England, when he heard that Professor Ostwald was selected for this office, had a hopeful anticipation that he would rival his compeers. You, fellow-workers, have listened to the mode in which he has passed through this great ordeal, and I am sure that you will all acknowledge the splendid achievement of his success. I think, Sir, we might even go farther and say that no greater enjoyment could have been given to Faraday, if we could imagine his being present here this evening, than to have received Professor Ostwald; for his life and spirit has been the spirit of Faraday, and that has led to his great position as a worker and to the establishment of his great school of physical chemistry. We may rest assured that the man who has done so much to develop the electro-chemical theory and the theory of dielectrics which originated in this place would have been a delight to Faraday. But I think we ought to go farther, and say that, while in the past we have had the eulogy of Faraday, while we have had admirable summations of his character and work by his admirers, we have never before had such an original pronouncement. We have received for the first time an original contribution that is likely to give us matter for thought for many a day to come. I think that the selection of the subject of the address in itself would have delighted Faraday, who again and again returned to the discussion of the nature of the elementary bodies. I was curious to ascertain what was the last pronouncement which Faraday gave in this room with regard to the elements; and I found it in a Friday evening lecture in the year 1836 (subsequent to his discovery of definite electrolysis), entitled "The Nature of the Chemical Elements." The last sentence is most interesting. He says: "Thus, either present elements are the true elements, or else there is the probability before us of obtaining *some more high and general power* of Nature even than electricity, which at the same time might reveal to us an entirely *new* grade of the elements of matter now hidden from our view and almost from our suspicion." That was Faraday's view sixty-eight years ago, given in this very room and at that very table. It is quite clear that at that time he would have been staggered if he could have known that a substance with which he was familiar, in the form of an oxide, and which had been taken for an element—namely, the substance uranium—contained within itself that very spontaneous change into the "new grade of the elements" which Professor Ostwald has so admirably illustrated.

The Professor's stalactite cavern is a cavern of great mystery, and is indeed one in which we may require a great deal more light before we can get acclimatised to the surroundings. But that does not withdraw one iota from the originality and the brilliancy of the lecture which we have had to-night, and I ask you, Sir, to allow me, on behalf of the Chemical Society and the world of English science to propose a vote of thanks to Professor Ostwald for the noble way in which he has discharged his duty.

Dr. THORPE: Ladies and Gentlemen, I rise at the bidding of the President to discharge what I feel to be a very honourable duty, namely, to join with Professor Dewar in giving expression to the gratitude which the Fellows of the Chemical Society feel to Professor Ostwald for the Faraday Lecture which he has given to night. The President has told you that one characteristic of the Faraday Lectures is that they are given in this hall, a hall which, of course, is hallowed by the associations of Faraday. Now, if anybody will cast a retrospective glance over the Faraday Lectures, they will find that there is one fundamental conception common to them all. However different they may seem at first sight, they are all concerned fundamentally with the idea of the essential nature of chemical action and the essential nature of elements and compounds. Now, if those two things be the characteristics, namely, that the Faraday Lectures are given here and that they are all concerned with that fundamental idea—Professor Dewar would seem to have proved that Faraday himself was the first Faraday Lecturer. I venture, however, to point out that in reality the first Faraday Lecturer was John Dalton, for it was from that very place which Professor Ostwald has just occupied that John Dalton, in the winter of 1809, developed before such an audience as we have here to-night the conceptions which are immortally associated with his name. It was to an audience which, I suppose, may have comprised men like Young, Wollaston, Sir Joseph Banks, and Humphry Davy himself, that John Dalton, in his characteristic, simple, straightforward, lucid way, laid before a Royal Institution audience the first "Faraday Lecture." I have the greatest possible pleasure, Ladies and Gentlemen, in echoing the sentiment which has been so eloquently expressed by my colleague, Professor Dewar, in asking you to tender to Professor Ostwald our most grateful thanks for the intellectual treat which he has afforded us to-night.

Lord RAYLEIGH: I wish the President had seen fit to call upon someone more conversant than I am with the course of chemical thought and speculation to speak to this resolution. I feel that I follow only at a distance, and, although anyone who has heard Professor Ostwald to-night could not fail to take up some valuable ideas, I think most of us must feel that a good deal of thought is required before we should be in a position to do justice to what has been laid before us. We certainly live in a very interesting time. Twenty or thirty years ago an idea was not uncommon, I think, that we understood tolerably well the general course of Nature, and that all that was wanted was to fill up certain details where difficulties of one sort or another had interfered with our acquiring adequate knowledge. I believe that the feeling at the present day among scientific men, and, perhaps, especially among those scientific men who have taken the largest part in recent work, would be a very much more modest one, and that most of us are quite prepared to recognise that we must face possible revolutions in those ideas which in many cases we have hitherto regarded as most firmly established. It is in connection with such thoughts that I think we recognise the value of what we have heard to-night, and I, certainly, for one shall look forward to studying in detail what has been set before us. I desire most heartily to support the resolution which has been moved and seconded.

The motion was then put by the PRESIDENT and carried with acclamation.

Professor OSTWALD : Mr. President, Ladies and Gentlemen :—Now that my task of reading from print is at an end, I feel a difficulty in going some steps farther into unknown English periods. I cannot bring sufficient English together to express my deep feeling of thanks for the honour which has been shown to me in the way in which you have received my ideas. I feel that I was not mistaken when I tried to bring this work into your own land in the face of one of the best things ever done in science, I mean the atomic hypothesis. My purpose was to show that the atomic hypothesis is no longer necessary to explain the stoichiometrical laws. But the views arrived at, and the progress attained by the use of the atomic hypothesis cannot be destroyed. They have directed the discoveries of chemistry for a whole century, and if any hypothesis can do good, this one has done so. Therefore I do not think this hypothesis need be interred yet, and when the time comes it should be interred with the greatest honour.

Wednesday, April 20th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. G. E. P. Broderick, H. W. Gadd, and T. S. Price were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Albert Ernest Bellars, B.A., Magdalene College, Cambridge.
Herbert Frank Brand, M.A., B.Sc., 13, Clifton Road, Brockley, S.E.
Thomas Alfred Gerard, 122, Foxhall Road, Nottingham.
James Gray Gilchrist, M.A., 48, Ovington Street, Chelsea, S.W.
John Haslam Johnston, M Sc., Public Offices, Hampton, Middlesex.
Alfred Pell, 44, Cumballa Hill, Bombay.
David John Pinkerton, 17, Orbiston Street, Motherwell.
Percy Richard Sanders, West Cliffe, Seaford, Sussex.
James Alfred Wilkinson, M.A., Transvaal Technical Institute, Johannesburg.

The PRESIDENT stated that the Council had resolved to present the following address to Sir Henry E. Roscoe on the occasion of the celebration of the Jubilee of his Doctorate, on Friday, April 22nd, 1904, fifty years having elapsed since he graduated as Doctor of Philosophy at Heidelberg on March 15th, 1854.

To SIR HENRY ENFIELD ROSCOE, Ph.D., LL.D., D.Sc., F.R.S.

The Officers and Council of the Chemical Society desire to join the rest of your Scientific friends in offering hearty congratulations on the attainment of the Jubilee of your Doctorate.

More than forty years ago, when there were few schools of scientific chemistry in this Country, by your teaching and example you not only revived the fortunes of the College in Manchester to which, during so many years, you were attached, but assisted in arousing a new spirit in the other teaching institutions of Great Britain.

They recall with pleasure and gratitude the services you rendered to the Society when, many years later, you became its President and by your genial personal influence assisted so materially in promoting its activity and usefulness.

They wish you many years of health to enjoy the further developments of Scientific Research and the further applications of Scientific Knowledge to useful purposes, to which the greater part of your life has been devoted.

(Signed.) WILLIAM A. TILDEN, *President.*
ALEXANDER SCOTT, *Treasurer.*
W. PALMER WYNNE }
M. O. FORSTER } *Secretaries.*
WILLIAM RAMSAY, *Foreign Secretary.*

Of the following papers, those marked * were read:

*58. "The vapour density of hydrazine hydrate." By Alexander Scott.

The determinations by Curtius and Schulz (*J. pr. Chem.*, 1890, [ii], 42, 529) of the vapour density of hydrazine hydrate at various temperatures are interpreted by them to indicate something quite anomalous in the behaviour of this substance in the state of vapour. They state that at 100° the vapour density determined by Hofmann's method corresponds with the molecule N_2H_4,H_2O, and at 170° at atmospheric pressure to $N_2H_4 + H_2O$, but that at higher temperatures larger molecules are largely regenerated and that at very high temperatures the vapour density indicates a molecular weight double that of the original. The author finds that at 98·8° the vapour density is 15·8 instead of 25 as required by N_2H_6O, at 138° the dissociation into $N_2H_4 + H_2O$ is complete, and that at higher temperatures, a certain amount of decomposition into nitrogen, ammonia, and water occurs. If the vapour densities by V. Meyer's method were determined in an atmosphere of air, oxidation of the hydrazine would ensue, leading to completely erroneous results, even at comparatively low temperatures, but by using nitrogen this source of error is avoided.

*59. "The combining volumes of carbon monoxide and oxygen." By Alexander Scott.

The ratio by volume in which carbon monoxide combines with oxygen has been determined by means of the same apparatus as was employed by the author in estimating the composition by volume of water (*Phil. Trans.*, 1893, **184**, A, 543). The results of the author's experiments indicate that the molecular concentration of carbon monoxide is slightly greater than that of oxygen, the combining volumes being $CO : O :: 1·9985 : 1$ with carbon monoxide from calcium oxalate and $1·9994 : 1$ with that from formic acid. Applying a correction for this to Lord Rayleigh's recently published value for the density of carbon monoxide so as to obtain its molecular weight, we obtain $CO = 27·99$ and $C = 11·99$.

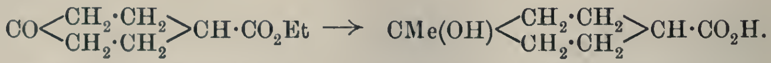
*60. "A revision of the atomic weight of rubidium." By Ebenezer Henry Archibald.

Commercial rubidium iodide was converted into the dichloriodide ($RbCl_2I$) and fractionally crystallised many times until the salt had become spectroscopically free from potassium, when the product was divided into four portions, which each received a different number of additional fractionations. In order to remove the cæsium, the rubidium was either repeatedly precipitated as chloride with hydrogen chloride or the hydrogen tartrate was fractionally crystallised. After being fused and bottled by means of Richards' bottling apparatus (*Proc. Amer. Acad.*, 1896, **32**, 55), four samples of rubidium chloride purified by these processes were analysed by precipitating the chlorine with silver nitrate, estimating the amount of silver required for complete precipitation, and also the amount of silver chloride produced. The mean values of the atomic weight of rubidium obtained from 14 analyses were 85·490 and 85·484 from the ratios $AgCl : RbCl$ and $Ag : RbCl$ respectively ($O = 16·0$).

Analyses of rubidium bromide led to the value 85·483, obtained from either of the ratios $AgBr : RbBr$ or $Ag : RbBr$.

*61. "Experiments on the synthesis of the terpenes. Part I. Synthesis of inactive terpineol, dipentene, and terpin hydrate." By William Henry Perkin, jun.

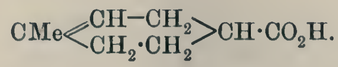
It was recently shown (*Trans.*, 1904, 85, 416) that pentane-$\alpha\gamma\epsilon$-tricarboxylic acid, $CO_2H\cdot CH(CH_2\cdot CH_2\cdot CO_2H)_2$, when digested with acetic anhydride and subsequently distilled, is converted into δ-ketohexahydrobenzoic acid. The ester of this acid reacts readily with magnesium methyl iodide, yielding, among other products, *cis*-δ-hydroxyhexahydro-*p*-toluic acid (compare Stephan and Helle, *Ber.*, 1902, 35, 2153):



$$\mathrm{CO}<\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CO_2Et} \longrightarrow \mathrm{CMe(OH)}<\substack{\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CO_2H}.$$

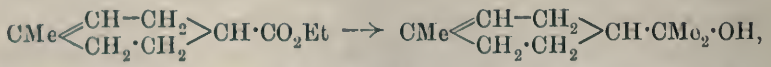
This acid melts at 153°, and on distillation is readily converted into its lactone, a solid, crystalline substance, which melts at 70° and distils at about 185° under 150 mm. pressure.

When the hydroxy-acid (or its lactone) is left in contact with fuming aqueous hydrobromic acid, it is converted into δ-bromohexahydro-*p*-toluic acid, a crystalline substance which melts at 126°, and which, when digested with pyridine or with sodium carbonate, yields Δ^3-tetrahydro-*p*-toluic acid (m. p. 99°):



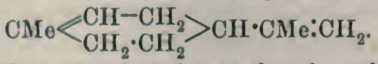
$$\mathrm{CMe}\lessdot\substack{\mathrm{CH-CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CO_2H}.$$

If the ester of this acid is mixed with an excess of an ethereal solution of magnesium methyl iodide, and the product, after remaining for 24 hours, is treated with dilute hydrochloric acid, a colourless oil is obtained, which distils at 133° under 60 mm. pressure and has a pronounced odour of lilac. That the above reaction takes place according to the scheme:



$$\mathrm{CMe}\lessdot\substack{\mathrm{CH-CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CO_2Et} \longrightarrow \mathrm{CMe}\lessdot\substack{\mathrm{CH-CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CMe_2\cdot OH},$$

and that the oil obtained is therefore inactive *terpineol* is clearly proved by the following facts. It yielded, on analysis, numbers agreeing with the formula $C_{10}H_{18}O$, and, when digested with potassium hydrogen sulphate, was converted almost quantitatively into dipentene,



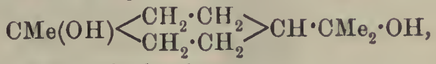
$$\mathrm{CMe}\lessdot\substack{\mathrm{CH-CH_2}\\ \mathrm{CH_2\cdot CH_2}}>\mathrm{CH\cdot CMe{:}CH_2}.$$

The *dipentene* thus synthesised was found to be identical in all respects with that obtained from ordinary terpineol by the same process. It distilled at 181—182°, had a characteristic odour of lemons, and yielded, with bromine, *dipentenetetrabromide*, $C_{10}H_{16}Br_4$ (m. p. 125°), and, with hydrogen chloride, *dipentene dihydrochloride*, $C_{10}H_{16},2HCl$ (m. p. 48—50°).

Furthermore, the synthetical terpineol was slowly converted by treatment with dilute sulphuric acid into terpin hydrate,

$$C_{10}H_{18}(OH)_2,H_2O$$

(m. p. 118°), from which terpin itself,



$$CMe(OH){<}\begin{matrix}CH_2\cdot CH_2\\ CH_2\cdot CH_2\end{matrix}{>}CH\cdot CMe_2\cdot OH,$$

was readily obtained by dehydration.

These experiments are being continued and extended to the study of the behaviour of ethyl γ-ketohexahydrobenzoate and other similarly constituted substances towards magnesium methyl iodide.

*62. "A lævorotatory modification of quercitol." By Frederick Belding Power and Frank Tutin.

Quercitol, $C_6H_{12}O_5$, has hitherto only been found in the fruits (acorns) of certain species of *Quercus*, in which it exists as a dextrorotatory modification. The lævorotatory modification described by the authors was obtained from the leaves of *Gymnema sylvestre* (Br.), a plant belonging to the family of *Asclepiadaceæ*, and indigenous to Banda and the Deccan Peninsula.

l-Quercitol is a colourless, crystalline substance, which, when crystallised from water, has the formula $C_6H_{12}O_5,H_2O$; it loses its molecule of water at 110°, melts at 174°, and has $[\alpha]_D\ -73{\cdot}9°$. The dried substance separates from ethyl alcohol in the anhydrous state. *Pentaacetyl*-l-*quercitol*, $C_6H_7(O\cdot C_2H_3O)_5$, crystallises from dilute alcohol in needles, melts at 124—125°, and has $[\alpha]_D\ -26{\cdot}0°$. *Pentabenzoyl*-l-*quercitol*, $C_6H_7(O\cdot C_7H_5O)_5$, separates from a mixture of alcohol, ethyl acetate, and petroleum in needles containing a molecule of alcohol, which, when heated slowly, melt at 148°; it has $[\alpha]_D\ -79{\cdot}0°$. On oxidising *l*-quercitol with sodium hypobromite and treating the product with phenylhydrazine, *diketotrihydroxyhexahydrobenzenedihydrazone*, $C_6H_5(OH)_3(:N\cdot NH\cdot C_6H_5)_2$, was obtained, which separates from alcohol in yellow needles and melts at 209°. On oxidising with cold potassium permanganate solution, malonic acid was obtained, and was identified by means of its ethyl ester.

Kiliani and Schaefer (*Ber.*, 1896, **29**, 1762) have shown that *d*-quercitol is a pentahydroxyhexahydrobenzene, by the formation, on the one hand, of malonic acid, and, on the other, of a diketone, $C_6H_8O_5$. The substance isolated by the authors, designated as *l*-quercitol, is, therefore, one of the eight possible isomerides of pentahydroxyhexahydrobenzene, but, until a further number of these have been isolated, it will be impossible to assign to either of the known quercitols a definite configuration.

*63. "The constituents of the essential oil of Californian laurel." By Frederick Belding Power and Frederic Herbert Lees.

The Californian laurel, *Umbellularia Californica* (Nuttall), a handsome, evergreen tree, occurring in California and Oregon, is also known as "mountain laurel," "cajeput," "spice tree," "California olive," "California bay tree" and "pepper-wood."

The essential oil of the leaves had a pale yellow colour and an odour which was at first agreeably aromatic, but when more strongly inhaled became exceedingly irritating to the mucous membranes of the nose and eyes, producing the effects that have previously been described. The oil had a sp. gr. 0·9483 at 16°/16°, and $[\alpha]_D$ $-22°$ in a 100 mm. tube; it was completely soluble in 1·5 parts of 70 per cent. alcohol. It was found to contain an inappreciable amount of esters and a very small quantity of a mixture of free fatty acids, including formic acid. The essential constituents of the oil were found to be: eugenol, *l*-pinene, cineol, safrole, eugenol methyl ether, veratric acid, and a new, unsaturated, cyclic ketone, *umbellulone*, $C_{10}H_{14}O$, which is a colourless liquid with a somewhat mint-like odour, having in a high degree the peculiar pungency of the original oil. It boils at 219—220° (corr.), has a sp. gr. of 0·9581 at 15°/15°, and $[\alpha]_D$ $-37°$. This ketone does not react normally with semicarbazide and hydroxylamine, affording with the former, *semicarbazidodihydroumbellulonesemicarbazone*, $C_{10}H_{15}{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2(CH_4ON_3)$ (m. p. 217°), and with the latter, *hydroxylaminodihydroumbelluloneoxime*,

$$C_{10}H_{15}({:}NOH){\cdot}NH{\cdot}OH$$

(compare *Ber.*, 1897, **30**, 230, 251; 1900, **33**, 562, and 1903, **36**, 4377).

The relative proportions of these constituents of the oil were approximately as follows: umbellulone, 60; cineol, 20; eugenol methyl ether, 10; pinene, 6, and eugenol, 1·7 per cent. respectively, together with a very small amount of safrole.

*64. "Some derivatives of umbellulone." By Frederic Herbert Lees.

With the view of elucidating the constitution of umbellulone, $C_{10}H_{14}O$, the new ketone isolated by Power and the author from the essential oil of Californian laurel, the following derivatives have been prepared.

Umbellulone combines directly in the cold with only 2 atomic proportions of bromine, forming *umbellulone dibromide*, $C_{10}H_{14}OBr_2$, an unstable oil. Umbellulone would therefore appear to contain only one ethylenic linking, and in consideration of this circumstance and the fact that, like the $\alpha\beta$-unsaturated ketones generally, it behaves abnormally towards hydroxylamine and semicarbazide, one molecule of the ketone interacting with two molecules of these bases respectively (compare preceding abstract), it is regarded as an $\alpha\beta$-unsaturated cyclic ketone containing two closed rings.

When umbellulone dibromide is heated under diminished pressure, it loses hydrogen bromide, yielding an *unsaturated bromo-ketone*, $C_{10}H_{13}OBr$ (b. p. 140—145°/20 mm.), and *dibromodihydroumbellulone*, $C_{10}H_{14}OBr_2$, which forms needles melting at 119—119·5° and having $[\alpha]_D + 6{\cdot}4°$ in chloroform. When the unsaturated bromo-ketone is reduced with zinc dust and acetic acid, a *saturated ketone*, $C_{10}H_{16}O$ (b. p. 214—217°), is produced; the *semicarbazone* of the latter $C_{10}H_{16}{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$, forms needles which melt at 171—172°.

When dibromodihydroumbellulone is reduced with zinc dust and acetic acid, it is converted into *bromodihydroumbellulone*, $C_{10}H_{15}OBr$, which forms needles melting at 58—59° and having $[\alpha]_D - 70{\cdot}1°$ in chloroform. When this bromo-derivative is reduced with sodium and alcohol, it gives *tetrahydroumbellulol*, $C_{10}H_{19}{\cdot}OH$ (b. p. 207—208°/760 mm.), which has a sp. gr. 0·9071 at 15°/15° and $[\alpha]_D - 6{\cdot}6°$.

Umbellulone is readily oxidised by cold potassium permanganate, yielding a *lactone*, $C_9H_{12}O_2$, together with several acids which have not yet been investigated.

The author wishes to reserve the further investigation of umbellulone.

65. "Ammoniacal double chromates and molybdates." By Samuel Henry Clifford Briggs.

A number of double salts of ammonium chromate belonging to a series of compounds having the general formula $M_2{}^IM^{II}(RO_4)_2,2NH_3$ have already been described (*Trans.*, 1903, 83, 391). Other members of the same series have now been prepared, M^I being either NH_4 or K; M^{II} being Cu, Zn, Cd, Co, or Ni, and R indicating either Cr or Mo. The corresponding tungstates could not be obtained.

The compounds $CuCrO_4,3\frac{1}{2}NH_3,\frac{1}{2}H_2O$; $CuMoO_4,2NH_3,H_2O$; $CuWO_4,4NH_3$, and $ZnWO_4,4NH_3,3H_2O$ have been incidentally prepared during the investigation.

66. "The hexahydrated double chromates. Magnesium and nickel compounds." By Samuel Henry Clifford Briggs.

The double chromates $M_2^IM^{II}(CrO_4)_2,6H_2O$, in which M^{II} is magnesium or nickel and M^I is K, Rb or Cs, have been prepared.

The nickel compounds were obtained by adding a solution of the alkali chromate to a solution of nickel acetate, at the ordinary temperature for the rubidium and cæsium salts and at − 6° for the potassium compound.

The magnesium compounds crystallised out when cold concentrated solutions of their components were mixed, the preparation of the potassium salt being carried out at − 10°.

Both the potassium compounds are very efflorescent at the ordinary temperature, whilst in the case of the series of salts in which M^{II} is the same, the stability increases with the atomic weight of the alkali metal. This variation is in the same sense as that found by Tutton (*Trans.*, 1896, 69, 521) for the relative stabilities of the corresponding double sulphates.

67. "Hydrocellulose." By Charles Frederick Cross and Edward John Bevan.

The residues described by Stern (*Trans.*, 1904, 85, 336) having the empirical composition of cellulose are no doubt products of hydrolysis and reversion, and are constitutionally different from the original cellulose; but they are in no case identical with those described by Girard, and therefore this investigator's exhaustive account of the actions of acids on cellulose remains unaffected by the criticisms contained in the above-mentioned paper. The statements (*loc. cit.*) as to the causes of the attendant structural changes are, moreover, improbable.

Cellulose is a chemically labile and structurally plastic aggregate, occupying an intermediate position between the two extremes, determined by the action of (*a*) alkali hydroxides, (*b*) the halogen hydracids, both in presence of water.

It is suggested that the terms hydracellulose and hydrocellulose respectively may for the present be retained to designate the two groups of derivatives obtained by the processes (*a*) and (*b*).

68. "Bornylcarbimide." By Martin Onslow Forster and Herbert Moore Attwell.

The appearance of a paper by Doht and Haager (*Monatsh.*, 1903, **24**, 844) dealing with the production of phenylcarbimide by the action of nitrous acid on phenylcarbamide leads us to record a similar observation which we have made in connection with bornylcarbamide.

Bornylcarbimide, $C_{10}H_{17}\cdot N\colon C\colon O$, prepared by adding solid sodium nitrite to bornylcarbamide nitrate suspended in water at 0°, is a colourless, crystalline substance which melts at 72°; it is very volatile, and the vapour is intensely pungent. A 2 per cent. solution in benzene has $[\alpha]_D +46\cdot5°$. It is hydrolysed by acids and alkalis, yielding bornylamine, whilst aniline converts it into bornylphenylcarbamide, previously obtained from bornylamine and phenylcarbimide (*Trans.*, 1898, **73**, 393).

Dibornylthiocarbamide, $S\colon C(NH\cdot C_{10}H_{17})_2$, obtained on heating bornylamine with carbon disulphide and alcohol until hydrogen sulphide is no longer liberated, melts at 227°.

Bornylamine bornyldithiocarbamate, $C_{10}H_{17}\cdot NH\cdot CS\cdot SH,C_{10}H_{17}\cdot NH_2$, is produced at the same time and melts at 78°.

Bornylamine thiocyanate crystallises from hot water in long, lustrous needles melting at 178°; above this temperature, it changes into dibornylthiocarbamide.

69. "Reduced silicates." By Charles Simmonds.

The substance left when lead silicates are reduced by heating in hydrogen (*Trans.*, 1903, **83**, 1449) is in general shown to be a compound which can be regarded as a combination of the metal and silica, in the same sense as the original silicate is a combination of the metallic oxide and silica. In some cases, however, a certain proportion of metallic lead is mixed with the substance: this occurs when the original silicates (for example, orthosilicates and basic silicates) contain a greater number of basic than of acidic oxides in the silicate molecule.

The reduced residues are generally more refractory than the original silicates. Treatment with the commoner acids and oxidising agents has little effect on them, but they are decomposed by hydrofluoric acid and by fusion with alkali carbonates. The term "silicites" is suggested for these reduced silicates.

Similar results were obtained with the silicates of copper, iron, nickel, and cobalt.

70. "Picryl derivatives of urethane and thiourethane." By James Codrington Crocker and Frank Harold Lowe.

The authors show that the reaction between picryl chloride, thiocyanates, and alcohols is due to the formation of the ψ-thiourethanes, PiN:C(SH)·OX, as intermediate products, which subsequently react with picryl chloride and pass into the picriminothiocarbonates, PiN:C(SPi)·OX. The results obtained with the cyanates, picryl chloride, and alcohol confirm this view. Under these conditions, the corresponding urethanes, PiNH·CO·OX, are formed, and in the case of ethyl alcohol, the picriminocarbonate, PiN:(OEt)·OPi, is also produced. The following compounds are described:

Picryl *iso*propyl picriminothiocarbonate, melting at 147°, and the corresponding amyl ester (m. p. 138·5°), picrylmethylurethane (192°), picryl-ethylurethane (147°), picryl-*n*-propylurethane (139°), picryl-*iso*propylurethane (177·5°), picryl-*iso*butylurethane (134°), picryl-amylurethane (131°), picryl ethyl picriminocarbonate (222°). Picryl thiocyanate is a crystalline powder which does not melt, but decomposes on heating.

The urethanes are tautomeric, the solutions in associated solvents being coloured, whilst those in non-associated solvents are colourless.

71. "The oxime of mesoxamide (*iso*nitrosomalonamide) and some allied compounds. Part III. Tetra-substituted derivatives." By Martha Annie Whiteley.

In a previous communication (Trans., 1903, **83**, 43) reference was made to *iso*nitrosomalondimethylanilide, $C_{17}H_{17}O_3N_3$ (m. p. 109°)—a tetra-substituted derivative of *iso*nitrosomalonamide—and to a compound (m. p. 192°), described as isomeric with it, which was obtained together with the corresponding ketone (m. p. 172°) by the action of nitrosyl chloride on malondimethylanilide. Although the examination of this abnormal reaction is still incomplete, the present note is put forward in consequence of the appearance of a paper on *iso*nitrosomalonamide by Ratz (*Monatsh.*, 1904, **25**, 55).

The compound melting at 192° (mol. wt. in naphthalene = 311) has the formula, $C_{17}H_{15}O_3N_3$ or $C_{17}H_{17}O_3N_3$, and on reduction with zinc dust and acetic acid or with aluminium amalgam, yields a compound, $C_{17}H_{17}O_2N_3$ or $C_{17}H_{19}O_2N_3$, which crystallises in colourless, prismatic needles and melts at 185—186°. When treated with alcoholic potassium or sodium hydroxide, it forms crystalline alkali salts, and from their solutions, mineral acids precipitate a crystalline acid, $C_9H_8O_3N_2$, melting with decomposition at 256°, which yields an *ethyl* ether, $C_9H_7O_3N_2Et$ (mol. wt. in naphthalene = 222), crystallising in octahedral prisms and melting at 168°.

Aminomalondimethylanilide, $(CO{\cdot}NPhMe)_2CH{\cdot}NH_2$, prepared by reducing *iso*nitrosomalondimethylanilide with zinc dust and acetic acid, forms highly refractive prisms melting at 108°.

Nitromalondimethylanilide, $(CO{\cdot}NPhMe)_2CH{\cdot}NO_2$, obtained together with the compound melting at 192° by the action of fuming nitric acid on *iso*nitrosomalondimethylanilide dissolved in chloroform saturated with nitrosyl chloride, forms colourless prisms melting with decomposition at 156°, yields crystalline, yellow alkali salts, and is readily reduced by zinc dust and acetic acid to mesoxdimethylanilide. When boiled with piperidine in alcoholic solution, nitromalondimethylanilide yields a white, crystalline compound melting at 184°, probably *dihydroxymalondimethylanilide*, $(CO{\cdot}NPhMe)_2C(OH)_2$, which has also been prepared from *iso*nitrosomalondimethylanilide by a similar method or by the action of potassium hypobromite.

Malontetraphenylamide, $(CO{\cdot}NPh_2)_2CH_2$, prepared by the action of diphenylamine on malonyl chloride, crystallises in colourless prisms melting with decomposition at 219—220°. The iso*nitroso*-derivative, $(CO{\cdot}NPh_2)_2C{:}N{\cdot}OH$, forms pale yellow prisms melting with decomposition at 237—238°. The *potassium* salt, $(CO{\cdot}NPh_2)_2C{:}N{\cdot}OK$, forming slender, yellow needles, gives with ferrous sulphate the rich bluish-purple precipitate characteristic of this group of oximes, and regenerates the *iso*nitroso-compound on treatment with mineral acids or carbon dioxide. The *acetyl* derivative (pale yellow prisms, m. p. 190°), the *benzoyl* derivative (colourless prisms, m. p. 175°), and the *ethyl* ether (m. p. 164—165°) have been prepared. The *amino*-derivative, $(CO{\cdot}NPh_2)_2CH{\cdot}NH_2$, crystallises in colourless prisms and melts at 200—201°.

Nitromalonanilide, $(CO{\cdot}NHPh)_2CH{\cdot}NO_2$ (m. p. 141°), is obtained together with a compound melting at 128° by the action of fuming nitric acid on *iso*nitrosomalonanilide dissolved in chloroform saturated with nitrosyl chloride. The *amino*-derivative, $(CO{\cdot}NHPh)_2CH{\cdot}NH_2$, forms white scales melting at 141—142°.

Malonmonophenylamide, $NHPh{\cdot}CO{\cdot}CH_2{\cdot}CO{\cdot}NH_2$, crystallises with $\frac{1}{2}H_2O$ and, when anhydrous, melts at 153—154° (Freund gives 163°); the iso*nitroso*-derivative, $NHPh{\cdot}CO{\cdot}C(CO{\cdot}NH_2){:}NOH$, forms needles melting at 180—181° with decomposition.

The investigation of the derivatives of *iso*nitrosomalonamide is being continued.

ERRATUM.

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Page.	Line.	
283	7	*for* "2/3-normal" *read* "normal."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on Thursday, May 5th, 1904, at 8 p.m., the following papers will be communicated:

"The slow combustion of ethane." By W. A. Bone and W. E. Stockings.

"Note on the hydrolysis of starch by diastase." By J. S. Ford.

"The resin acids of the *Coniferæ*. Part I. The constitution of abietic acid." By T. H. Easterfield and G. Bagley.

"The action of radium rays on the halides of the alkali metals and analogous heat effects." By W. Ackroyd.

"The dynamic isomerism of glucose and of galactose. Solubility as a means of determining the proportions of dynamic isomerides in equilibrium." By T. M. Lowry.

"A study of the substitution products of *ar*-tetrahydro-α-naphthylamine. 4-Bromo-*ar*-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid." By G. T. Morgan, F. M. G. Micklethwait, and H. B. Winfield.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Classen, A. Ausgewählte Methoden der analytischen Chemie. Unter Mitwirkung von H. Cloeren. Band II. pp. xvi + 831. ill. Braunschweig 1903. From the Publishers.

Curie, Mme. S. Untersuchungen über die radioaktiven Substanzen. Uebersetzt und mit Litteratur-Ergänzungen versehen von W. Kaufmann. pp. viii + 132. Braunschweig 1904. From the Publishers.

Green, Arthur G. A systematic survey of the organic colouring matters. Founded on the German of G. Schultz and P. Julius. 2nd edition. pp. x + 280. London 1904. From the Author.

Guinness Research Laboratory. Transactions. Edited by Horace T. Brown. Vol. I. Part I. pp. 141. ill. 1903.
From Messrs. A. Guinness, Son & Co.

Heumann, Karl. Anleitung zum Experimentieren bei Vorlesungen über anorganische Chemie. Von O. Kühling. Dritte Auflage. pp. xxix + 818. ill. Braunschweig 1904. From the Publishers.

Imperial Institute. Technical reports, and scientific papers. Edited by Wyndham R. Dunstan. With a preface by the late Sir Frederick Abel, Bart. pp. xlvii + 236. London 1903.
From Professor W. R. Dunstan.

Peterson-Kinberg, Willy. Wie eine moderne Teerdestillation mit Dachpappenfabrik eingerichtet sein muss. pp. viii + 224. ill. Wien und Leipzig 1904. From the Publishers.

II. *By Purchase.*

Bischof, Carl. Gesammelte Analysen der in der Thonindustrie benutzten Mineralien und der daraus hergestellten Fabrikate. pp. 165. Leipzig 1901.

Böhmer, C. Die Kraftfuttermittel, ihre Rohstoffe, Herstellung, Zusammensetzung, Verdaulichkeit und Verwendung, mit besonderer Berücksichtigung der Verfälschungen und der mikroskopischen Untersuchung. pp. xi + 650. ill. Berlin 1903.

Gildemeister, Eduard, and Hoffmann, Friedrich. The volatile oils. Authorised translation by Edward Kremers. pp. 733. ill. Milwaukee 1900.

Maercker, Max. Handbuch der Spiritusfabrikation. Achte, vollständig neubearbeitete Auflage, hrsg. von Dr. Max Delbrück. pp. xx + 940. ill. Berlin 1903.

Mann, J. Dixon. Forensic medicine and toxicology. 3rd edition, revised and enlarged. pp. 692. ill. London 1902.

Nernst, Walther. Theoretische Chemie vom Standpunkte der Avogadroschen Regel und der Thermodynamik. 4 Aufl. pp. xiv + 749. ill. Stuttgart 1903.

Oppenheimer, Carl. Die Fermente und ihre Wirkungen. 2 Aufl. pp. viii + 440. Leipzig 1903.

Robine, R., et Lenglen, M. L'industrie des cyanures. Étude théorique et industrielle. pp. 463. ill. Paris 1903.

Schmidt, Julius. Ueber die basischen Eigenschaften des Sauerstoffs und Kohlenstoffs. pp. 111. Berlin 1904.

Seger, Hermann August. Gesammelte Schriften. Herausgegeben von H. Hecht und F. Cramer. pp. xv + 908. Berlin 1896.

Swithinbank, Harold, and Newman, George. Bacteriology of milk. With special chapters on the spread of disease by milk and the control of the milk supply. pp. xx + 605. ill. London 1903.

Tammann, Gustav. Kristallisieren und Schmelzen. Ein Beitrag zur Lehre der Änderungen des Aggregatzustandes. pp. x + 348. ill. Leipzig 1903.

Walker, James. Introduction to physical chemistry. 3rd ed. pp. 368. ill. London 1903.

Weber, Wilhelm, und Kohlrausch, Rudolf. Fünf Abhandlungen über Absolute elektrische Strom- und Widerstandsmessung. Herausgegeben von Friedrich Kohlrausch (Ostwald's *Klassiker*, No. 142). Leipzig 1904.

III. *Pamphlets.*

Atwater, W. O., and Benedict, F. G. Experiments on the metabolism of matter and energy in the human body. (U. S. Dept. of Agriculture, Office of Experiment Stations. Bulletin No. 136.) Washington 1903.

Baskerville, Charles. The elements: verified and unverified. (From the *Proc. Amer. Assoc. Advance. Sci.*, 53, 1904.)

Baskerville, Charles, and Kunz, George F. Effects on rare earth oxides produced by radium-barium compounds and on the production of permanently luminous preparations by mixing the latter with powdered minerals. (From the *Amer. J. Sci.*, 17.)

Baskerville, Charles, and Turrentine, J. W. Contributions to the chemistry of the rare earths. (From the *J. Amer. Chem. Soc.*, 26.)

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 5th, 1904.

Barbour William, M.A., B.Sc.

Grove Villa, Waltham Cross.

Chemist, Royal Gunpowder Factory, Waltham Abbey, Essex. Medallist in Mathematics and Chemistry and Berry Scholar in Science, St. Andrews; joint author with Professor Purdie of paper on "The Influence of Solvents on the Rotatory Powers of Dimethoxysuccinates and Tartrates" (Trans., 1901, vol. 79); Science master, Grammar School, Southwell, Notts.; chemist, R.G.P.F., since July, 1901.

Thomas Purdie. Alex. Findlay.
Alex. McKenzie. G. Druce Lander.
James Walker.

Benn, R. H. Durward,

Westmount, Montreal, Canada.

Analytical Chemist, with Dr. J. T. Donald, Dom. Govt. Analyst. Engaged in the study and practice of Pharmaceutical and Analytical Chemistry over eight (8) years. Studied partially at McGill University and partially at Bishop's College. Member Soc. Chem. Industry, Canadian Sect.

B. J. Harrington. T. E. Vasey.
J. Bemrose. *G. P. Girdwood.*
Jeffrey H. Burland.

Bridgett, Robert Currie,

32, Queen Anne Street, Dunfermline, Fifeshire.

Science and Mathematical Teacher, The Academy, Rothesay, N.B. M.A., B.Sc. St. Andrews. Late Berry Scholar in Chemistry, St. Andrews. Joint author with Professor Purdie, St. Andrews, of a paper entitled "Trimethyl α-Methylglucoside and Trimethyl Glucose" (Trans., 1903, **83**, 1037).

Thomas Purdie.	G. D. Lander.
Alex. McKenzie.	W. A. Greaves.

James Walker.

Clayton, Ellis,

6, Spring Hurst Road, Saltaire.

Chemist to Messrs. Sir Titus Salt., Bart., Sons & Co., Ltd., Saltaire. Late Demonstrator in Dyeing, Bradford Municipal Technical College. Three years assistant dyer and chemist, Newton Bank Print Works, Hyde. In 1899 held local scholarship of the value of £10 (Worshipful Company of Drapers) in Chemistry and Physics at the Haginbottom Technical School, Ashton-u.-Lyne. In 1900 obtained 1st place and silver medal in Honours calico printing (City and Guilds), and was awarded the Dyers Scholarship, value £63 per annum for 3 years, open to all those in England engaged in dyeing, printing, &c., and tenable in the Chemistry and Dyeing Department of the Bradford Municipal Technical College. Contributed two papers on dyeing, &c., to the Journal of the Society of Dyers and Colourists. In 1903 obtained Diploma of the Bradford College, and silver medal in silk-dyeing, 1st place Honours (City and Guilds). Have taken 1st class advanced certificates in practical and theoretical Inorganic and Organic Chemistry (Board of Education), and also 1st class Honours certificates in Cotton Dyeing, Wool Dyeing, Silk Dyeing, Calico and Linen Bleaching, and Calico Printing under the City and Guilds of London Institute.

George W. Slatter.	Barker North.
Walter M. Gardner.	A. B. Knaggs.

Samuel F. Stell.

Finlow, Robert Steel,

* The Research Station, Pemberandah, Dalsingh Serai
Tirhoot State Railway, Bengal.

Assistant Chemist at the above Research Station. General Education at Sandbach School, Cheshire (1887—1893). Proceeded to University College, Bangor, 1893. Graduated B.Sc. (Wales) 1899.

* This Research Station is supported entirely by the Government of Bengal.

Private Assistant to Professors Dobbie and Hartley in their work on "Absorption Spectra of Organic Compounds," 1899—1900. Assistant Chemist under Dr. Geo. McGowan to the Royal Commission on Sewage Disposal, 1900—1903. Assisted Dr. McGowan in his work for the Royal Commission on Arsenical Poisoning, 1901—1903. Joint author with Dr. McGowan of the following papers: (1) "Methods Employed in Testing for Arsenic in various Samples of Foods and other Substances . . . . "; (2) "Mechanical Analysis of Soils and Subsoils, together with deductions drawn from this" (in course of publication). At present engaged with Professor Bloxam at the Dalsingh Serai Research Station, in the investigation of the chemistry of Indigo.

James J. Dobbie.
George McGowan.
William Ramsay.
W. N. Hartley.
W. Popplewell Bloxam.
Alexander Lauder.
R. B. Floris.
Morris W. Travers.

Hammond, Harold Sankey,
Government Laboratory, Kingston, Jamaica.

Assistant to the Government Analytical and Agricultural Chemist in Jamaica. Worked for two years with Mr. Sidney Harvey, Public Analyst. Obtained Diploma of S.E. Agricultural College, Aug., 1899, "Experiments upon the Effect of Boracic Acid and Formalin upon the Live Weight, Growth, and Food Assimilation of Young Pigs," by A. D. Hall and H. S. Hammond; in collaboration with Professor Tunnicliffe, M.D. (Report of the Committee on Food Preservatives). "The Determination of Available Phosphoric Acid and Potash in Calcareous Soils," by H. H. Cousins and H. S. Hammond (*Analyst*, Aug., 1903.)

Sidney Harvey.
A. D. Hall.
Albert Howard.
E. J. Russell.
H. H. Cousins.
N. H. J. Miller.
Bernard Dyer.

Horn, George Mathieson,
Ivylands, Epping.

Analytical Chemist. Eighteen months at Marburg University, Hessen-Nassau, Chemistry. Two years at S.E.A. College, Wye, studying Technical Chemistry.

Alfred Edward Beanes.
F. Evershed.
W. S. Simpson.
R. J. Friswell.
John Spiller.

Le May, Percy Kent,

6, Lothair Villas, Hatfield, Herts.

Head Brewer to the Hatfield and Harpenden Breweries, Limited. Have studied Chemistry as applied to Brewing and Malting under Mr. John Heron at his Laboratory, 110, Fenchurch Street, and am desirous of being admitted to the Chemical Society in order to extend my knowledge of Pure Chemistry. I am continually at work in the Laboratory here.

Lyndon C. Wilson.
John Heron.
Francis Jewson.
Alfred C. Young.
Leonard Temple Thorne.
E. Haynes Jeffers.

Mander, Alfred,

Berkswell, Malvern.

Pharmaceutical Chemist. Bell Scholar 1887. Chemistry, 1st course, 1st Certificate of Honour. Botany, 1st course, 1st Certificate of Honour. Session Chemistry, 1st Certificate of Honour. Botany, Silver Medal; Pharmacy, Silver Medal; Practical Chemistry, 3rd Certificate of Honour, 1888. Major Examination, 1888. Pharmaceutical Society's Medal (Silver), 1889. Pharmacist in analytical work. Author of "The Analysis of Snow" (*Pharm. Journal*, 1891), "Ghatti and other substitutes for Gum Arabic" (*Pharm. Journal*, 1888), "The Climate of Malvern" (Stevens & Co.), 1903. Elected Fellow of the Royal Meteorological Society, November, 1899.

John Attfield.
Wyndham R. Dunstan.
Joseph Ince.
Thomas A. Henry.
Ernest Goulding.

Moore, Tom Sidney,

99, Rann Street, Ladywood, Birmingham.

Lecturer and Demonstrator in Chemistry at the University of Birmingham. B.A. (Oxford 1st Class Hons. in School of Nat. Sci.), 1902. B.Sc. (London, 1st Class Hons. and Scholarship in Chemistry), 1903. *Published papers*: Uber die Salz- und Hydrat-Bildung der Azophenole [with J. T. Hewitt and A. E. Pitt] (*Ber.*, 1898, pp. 2114–2123), The Reversibility of Voltaic Cells (*Phil. Mag.*, 1900, pp. 491—496), Modification of Zeisel's Method for Estimation of Methoxyl Groups [with J. T. Hewitt] (*J. C. S.*, 1902, pp. 318—321).

Percy. F. Frankland.
J. T. Hewitt.
Alex. Findlay.
Alex. McKenzie.
Thomas H. Pope.

Smith, Gerald Oscar Morgan,

The Studio, Trowse, Norwich.

Science Master. Studied Chemistry for three years at the Manchester Technical School. Teacher of Science in the Wallingford Grammar School for two years. Board of Education advanced Certificates for Inorganic Chemistry (Pract. and Theor.), and Metallurgy (Pract.). City and Guilds of London Institute Certificate for Science of Brewing. At present waiting for the Examination for post of Assistant Chemist at Woolwich.

George Embrey. Jas. Grant.
R. S. Cahill. *J. M. Collett.*
E. C. Womersley.

Oldfield, Laurel Cecil Francis,

Lincoln College, Oxford.

Student of Chemistry.

H. Brereton Baker. N. V. Sidgwick.
Allan F. Walden. R. Tabor Lattey.
D. H. Nagel.

Page, William Davidge,

Constitutional Club, London, W.C.

Engineer. Proprietor of a monthly technical journal, "Page's Magazine." Interest in Chemistry. Desirous of attending Meetings and of receiving the Transactions, and of making use of the Library.

David. A. Louis. F. Evershed.
J. Lewkowitsch. *Frederick Jas. M. Page.*
R. J. Friswell.

Pinchbeck, Gerald,

96, Albany Street, Regent's Park, N.W.

Pharmaceutical and Analytical Chemist. Major graduate of the Pharmaceutical Society. Member of the Pharmaceutical Society. Late Demonstrator in practical Chemistry and Physics at the London College of Chemistry. Contributor of the following scientific articles and notes published in the *Pharmaceutical Journal*:—"Arsenic in Sulphuric Acid" (1900), "Floral Calendar for January" (1899), "A Curious Hypertrophy of *Citrus Aurantium Risso*" (1903), "The Morphology and Pharmacognosy of *Berberis vulgaris*" (1900).

J. Bernard Coleman. J. Archyll Jones.
John M. Thomson. *Walter Hills.*
F. Stanley Kipping.

Porter, Thomas Linton Daniel,

161, Downsell Road, Stratford New Town.

Schoolmaster. For 2 years a Science Student at King's College, London. Medallist and Exhibitioner in Natural Science, King's College. For the past 2½ years Head Science Master at the Park Higher Grade School, Ilford, Essex. Bachelor of Science, London University.

John M. Thomson. Patrick H. Kirkaldy.
Herbert Jackson. W. D. Halliburton.
D. Northall-Laurie.

Riley, Louis John Ezekiel,

Port of Spain, Trinidad, B.W.I.

Student of Chemistry. Received general education at St. Mary's College, Port of Spain, Trinidad, B.W.I., obtaining Junior and Senior Cambridge Local Examination Certificates in 1896 and 1897 respectively. Studied Chemistry and allied subjects at University of Edinburgh during 1899–1901. Same studies were continued at the Glasgow and West of Scotland Technical College, 1900–1903. Passed the Intermediate Examination of the Institute of Chemistry, July, 1903, and now preparing for the Final Examination of the Institute at King's College, London.

John M. Thomson. Thomas Gray.
G. G. Henderson. Herbert Jackson.
Patrick H. Kirkaldy.

Robertson, Franklin Ernest,

Gloster House, Harders Road, Peckham, London, S.E.

Chemist and Manager of Dyeing (father's business). Studied Chemistry and Dyeing at the Bradford Municipal Technical College under Mr. W. M. Gardner, Dr. Sutherst, Dr. A. W. Gilbody, and Mr. Knaggs, taking a special two years' course. Holder at the College of the Dreyfus Scholarship, open to all engaged in the dyeing trade. Have the Chemistry and Dyeing certificates of the Bradford College, Board of Education advanced Certificate in Chemistry, City and Guilds Honours in Silk and Cotton and ordinary Certificates in Wool dyeing. Since leaving the College have continued my studies in Dyeworks in Zurich, Elberfeld (Bayers), Barmen and under Mr. Loewenthal at Cassella's (Frankfort). Author of "Note on the Effect of Sodium Chloride in the Estimation of free Alkaline Hydrate and Carbonate in Soap," Published *Journ. Soc. Dyers and Colorists*, July, 1901.

C. F. Cross. Walter M. Gardner.
Fredk. Hudson-Cox. A. B. Knaggs.
B. North.

Shacklady, Thomas George,

Addiscombe Villas, Cliff-at-Hoo, Rochester, Kent.

Technical chemist. Chief chemist Messrs. Curtis and Harvey, Explosive Factory, Cliffe. Member Society of Chemical Industry.

W. B. Roberts. E. Dowzard.
F. H. Tate. *Fred. R. Stone.*
Charles J. Smith.

Smith, Clarence,

Denmark Lodge, St. James', Hatcham, S.E.

Lecturer at E. London Technical College, Mile End Road. 1897—9 Teaching-Scholar, Royal College of Science, S. Kensington. 1903. Lecturer and Demonstrator, University College, Gower Street. 1903—present time, Lecturer and Demonstrator, E. London Technical College. D.Sc. (Lond 1903). Thesis: *ar*-Tetrahydro-β-naphthylamine.

William A. Tilden. H. Burrows.
J. T. Hewitt. Chapman Jones.
G. T. Morgan. James C. Philip.

Smith, Henry Heron,

76, Plumstead Common Rd., Plumstead.

Analytical Chemist. 1st Assistant Metallurgist, Royal Gun Factories, Royal Arsenal, Woolwich.

Wesley J. Lambert. W. Kellner.
Richard J. Redding. J. C. Aylan.
H. Russell Pitt. A. H. Mundey.

Stanger, Reginald Harry Hursthouse,

33, Ladbroke Grove, London, W.

Inspecting, Testing, and Consulting Engineer, and in conjunction with his engineering profession engaged in carrying out investigations, &c., at his Chemical Laboratories and Testing Works, 2, Broadway, Westminster, S.W.

Horace T. Brown. L. Pyke.
Henry E. Armstrong. *H. Harding.*
Gerald T. Moody. *William Robertson.*

de Jersey Fleming-Struthers, Robert,

Exeter College, Oxford.

B.A. of Oxford University. Has studied Chemistry for four years at Oxford University, and graduated with Honours in this subject.

Is at present engaged in research work on Chemistry with Mr. Marsh.

John Watts.	W. W. Fisher.
William Odling.	Allan F. Walden.

J. E. Marsh.

Tong, Walter,

"Holmdene," Pole Lane, Failsworth, Manchester.

Analyst, &c., in the employ of Messrs. Grimshaw Bros. & Co., Ltd., Clayton, Manchester. I have studied Chemistry 3 years at the Municipal School of Technology, having obtained Hons. Part I Inorganic (Practical); also part author of a paper read before the Society of Chemical Industry (Manchester Section), March, 1903, on the Analysis of Manufactured India-rubber. The paper was read by Messrs. Grimshaw, Tong, & Barnes.

William J. Pope.	F. S. Sinnatt.
John Allan.	J. H. Wolfenden.
L. G. Radcliffe.	Stanley J. Peachey.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 14/5/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 280.

May 5th, 1904. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. C. M. Beadnell, C. T. Bennett, and T. U. Walton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

W. Eddington Field, 65, Sutherland Road, Armadale, Melbourne, Victoria, Australia.

John Hulme, 3, Albert Terrace, Stockport.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

William Barbour, M.A., B.Sc.
R. H. Durward Benn.
Robert Currie Bridgett, M.A., B.Sc.
Ellis Clayton.
Robert Steel Finlow, B.Sc.
Harold Sankey Hammond.
George Mathieson Horn.
Percy Kent Le May.
Alfred Mander.
Tom Sidney Moore, B.A., B.Sc.
Gerald Oscar Morgan Smith.
Laurel Cecil Francis Oldfield.
William Davidge Page.
Gerald Pinchbeck.
Thos. Linton Daniel Porter, B.Sc.
Louis John Ezekiel Riley.
Franklin Ernest Robertson.
Thomas George Shacklady.
Clarence Smith, D.Sc.
Henry Heron Smith.
Reginald Harry H. Stanger.
Robert de J. Fleming-Struthers, B.A.
Walter Tong.

The PRESIDENT announced that the following persons were proposed by the Council for election as Foreign Members.

Henri Becquerel.	Madame Marie Curie.
Cornelis Lobry de Bruyn.	Carl Liebermann.
Frank Wigglesworth Clarke.	Edward Williams Morley.

and stated that in accordance with Bye-Law II. the ballot for their election would take place at the next meeting of the Society on Wednesday, May 18th.

The PRESIDENT announced that the following letter had been received from Sir Henry Roscoe in reply to the address of congratulation from the Society on the occasion of the celebration of the Jubilee of his Doctorate.

" 'To the Council and Fellows of the Chemical Society I offer my hearty thanks for the honour they have done me through the President, Professor Tilden.

'Instituted in 1841 for the purpose of stimulating chemical research in this country by the leaders of our science of that day, amongst whom Thomas Graham stands pre-eminent, the influence which the Society has exerted during more than half a century on the progress of English Chemistry has been far greater than its Founders could have foreseen.

'During the last fifty years our Science has undergone not one but many revolutions, each one widening and deepening its foundations.

'In this wonderful series of changes, thanks to the zeal and ability of its Fellows, both young and old, the Chemical Society has borne no inconsiderable part, and for its still wider influence and its still greater activity no one has warmer wishes than myself.

(Signed) HENRY E. ROSCOE.' "

Of the following papers, those marked * were read:

*72. "The slow combustion of ethane." By William Arthur Bone and William Ernest Stockings.

The authors have studied (1) the interaction of ethane and oxygen at 250—400°, under pressures of 1·75 to 2·33 atmospheres, in borosilicate glass bulbs (compare *Trans.*, 1902, 81, 536); (2) the oxidation of ethane in contact with a surface of porous porcelain at 400—500°, under reduced pressure, in the circulation apparatus described in a previous paper (*Trans.*, 1903, 83, 1074), and (3) the slow combustion of ethyl alcohol and acetaldehyde. The main conclusions deduced from the experiments are as follows :

(1) The proportions of ethane and oxygen most favourable to chemical change are equimolecular (1 : 1), although interaction takes place nearly as rapidly in mixtures containing ethane and oxygen in the ratio 2 : 1. At all temperatures, ethane is oxidised much more rapidly than is methane, other conditions being equal.

(2) When ethane is treated with proportions of oxygen insufficient to oxidise the whole to carbon monoxide and steam, there is no preferential combustion either of hydrogen or carbon. In the absence of secondary phenomena, the interaction is always marked by a diminution in the pressure of the cold products without any deposition of carbon or liberation of free hydrogen.

(3) The combustion proceeds in several well-defined stages, among which the following have been distinguished :

(i) A primary oxidation to acetaldehyde and steam.

(ii) A further rapid oxidation of the acetaldehyde to formaldehyde, carbon monoxide, and steam.

(iii) The final oxidation of formaldehyde to carbon monoxide, carbon dioxide, and steam, which may best be considered as due to two simultaneous interactions (i) $CH_2O + O_2 = CO_2 + H_2O$, (ii) $2CH_2O + O_2 = 2CO + 2H_2O$.

(4) The combustion of the hydrocarbon may be accompanied by the following secondary phenomena :

(i) Hydrogen or methane, or both, may appear in the products without any liberation of carbon, as the result of the purely thermal decompositions of formaldehyde and acetaldehyde vapours respectively, the latter giving rise to methane and carbon monoxide, whilst the former yields hydrogen and carbon monoxide, although its decomposition is a more complex process than that of acetaldehyde.

(ii) Small quantities of ethylene and hydrogen may appear in the products as the result of the thermal decomposition of ethane.

(iii) If the heat liberated during the initial stages of oxidation is sufficient to raise the temperature of the interacting gases to the ignition point, an explosion takes place, during which the excess of hydrocarbon, and probably also of aldehyde vapours, is decomposed, carbon and hydrogen being liberated together with some acetylene and ethylene. There is no liberation of carbon below the ignition point.

(5) Although ethyl alcohol has not been detected among the oxidation products of ethane, its absence may be explained by the fact that it is oxidised far more rapidly than is ethane under similar conditions.

(6) The view taken of the mechanism of the combustion of ethane is supported by the experiments on ethyl alcohol and acetaldehyde.

*73. "The action of radium rays on the halides of the alkali metals and analogous effects produced by heat." By William Ackroyd.

The author has studied the action of γ-rays from radium bromide, in its violet glass tube, on the chlorides of lithium, sodium, potassium, rubidium and cæsium, and deduces the following conclusions:

(1) The colour changes produced divide the compounds into two subgroups: I. LiCl, NaCl, and II. KCl, RbCl, CsCl, and in the effects observed: LiCl, white; NaCl, orange; KCl, violet; RbCl, bluish-green, and CsCl, green, each sub-group conforms to the constitutive-colour law (*Chem. News*, 1893, **67**, 27).

(2) The division into these sub-groups is also indicated by their differences of molecular aggregation as expressed by 1/sp. vol.

(3) There is relative stability of the colours produced while they remain in darkness, and their rate of disappearance or decay in daylight varies with the intensity of the light.

(4) The relative expenditure of energy in the γ-rays effecting the colour changes decreases with increase of molecular weight, or, in other words, the sensibility to the action of the γ-rays increases with the molecular weight.

(5) When the induced phosphorescence has decayed so as to be no longer visible, it can be revived by invisible heat. In the case of fused lithium chloride, a temperature of 37° is sufficient for the purpose.

(6) These various features correspond in many respects with the thermal effects produced in other substances, and the whole of the evidence points to the conclusion that both are physical changes.

*74. "The mutarotation of glucose and of galactose. Solubility as a means of determining the proportions of dynamic isomerides in equilibrium." By Thomas Martin Lowry.

The method formerly described (*Proc.*, 1903, **19**, 156) and applied to the case of β-bromonitrocamphor has now been used in order to determine the proportion of α-glucose and of α-galactose in the mixtures of dynamic isomerides which are formed when these sugars are dissolved in alcohol or in water. The solubility of α-glucose in anhydrous methyl alcohol gradually increases in the course of a week in the ratio of 0·53 : 1 and that of α-galactose in the ratio 0·50 : 1. The increment of solubility is due to the formation in solution of the stereoisomeric β-glucose (Tanret's γ-glucose) and β-galactose; when equilibrium is reached, the quantity of sugar in solution is nearly twice as great as when the α-form alone is present, and the stereoisomerides must therefore be in approximately equal proportion and be almost equally stable. This result differs from that obtained by Jungius in the case of the methyl-glucosides, for which the ratio was found to be $\alpha : \beta = 3 : 1$ instead of $1 : 1$.

In a mixture having approximately the composition $EtOH + H_2O$, the solubility of α-galactose was found to increase in the ratio 0·39 : 1, and in a mixture having approximately the composition $PrOH + 2H_2O$ in the ratio 0·35 : 1. The decrease of the ratio in the aqueous-alcoholic solutions may be attributed to the presence in the solution, along with the stereoisomeric α- and β-galactoses, of a considerable proportion of the hydrated aldehydic form of the sugar, which is probably an intermediate product in the isomeric change (compare *Trans.*, 1903, **83**, 1316); this conclusion is in harmony with the fact that the rate of change is many times greater than in the anhydrous methyl-alcoholic solutions.

Similar experiments were made on the dissolution of α-glucose in mixtures having approximately the composition $2EtOH + H_2O$ and $EtOH + H_2O$, but in each case the gradual increase of solubility was preceded by a more or less rapid decrease owing to the conversion of the solid α-glucose into a less soluble hydrate.

*75. "A study of the substitution products of *ar*-tetrahydro-α-naphthylamine. 4-Bromo-*ar*-tetrahydro-α-naphthylamine and *ar*-tetrahydro-α-naphthylamine-4-sulphonic acid." By Gilbert Thomas Morgan, Frances Mary Gore Micklethwait, and Herbert Ben Winfield.

The acyl derivatives of *ar*-tetrahydro-α-naphthylamine (Bamberger and Althause, *Ber.*, 1888, **21**, 1895), when brominated with one molecular proportion of the halogen or hypobromous acid, ultimately undergo substitution in the aromatic ring, the entrant bromine atom assuming the para-position with respect to the aminic nitrogen. The bromo-base obtained on hydrolysis was shown to be 4-*bromo*-ar-*tetrahydro-α-naphthylamine* (m. p. 42°) by furnishing successively 1-bromotetrahydronaphthalene and 1-*bromodinitrotetrahydronaphthalene* (m. p. 91°). The isomeric 2-*bromodinitrotetrahydronaphthalene* prepared from *ar*-tetrahydro-β-naphthylamine for the purpose of comparison melted at 105—106°. On treatment with diazo-compounds, the bromo-base yields diazoamines of the type $C_{10}H_{10}Br{\cdot}NH{\cdot}N_2X$. For example, 4 : 4′-*dibromo*-1-*diazo*-1-*aminotetrahydronaphthalene* prepared by the interaction of the base with its own diazonium salt, decomposes violently at 190—194°, and when treated with cold concentrated hydrochloric acid undergoes fission, yielding the hydrochlorides of its generators, the diazonium chloride being identified by the formation of 4-*bromotetrahydronaphthaleneazo-β-naphthol* (m. p. 215°).

4-Bromo-α-naphthylamine, unlike the analogously substituted tetrahydro-base, condenses with diazo-compounds to form ortho-azo-derivatives having the general formula $XN_2 \cdot C_{10}H_5Br \cdot NH_2$. The *azo-compound*, $NaSO_3 \cdot C_6H_4 \cdot N_2 \cdot C_{10}H_5Br \cdot NH_2$, yields, on reduction, sulphanilic acid and naphthylene-1 : 2-diamine.

ar-*Tetrahydro-α-naphthylamine*-4-*sulphonic acid*,

$$NH_2 \cdot C_{10}H_{10} \cdot SO_3H,H_2O,$$

produced by sulphonating *ar*-tetrahydro-α-naphthylamine, was converted into *tetrahydronaphthalene*-1-*sulphonic acid* by eliminating its amino-group, the same product being also obtained by replacing this radicle in *ar*-tetrahydro-α-naphthylamine by the SO_2H group and oxidising the *tetrahydronaphthalene*-1-*sulphinic acid* thus produced. *Tetrahydronaphthalene*-1-*sulphonic chloride* and the corresponding *anilide* melt at 70·5° and 144—145° respectively.

ar-Tetrahydro-α-naphthylamine-4-sulphonic acid differs from α-naphthylamine-4-sulphonic (naphthionic) acid in yielding diazoamino-derivatives and not azo-compounds.

The azo-derivatives of *ar*-tetrahydro-α-naphthylamine were shown to be para-azo-compounds like the corresponding azo-α-naphthylamines, for, on reduction, they give rise to *ar*-tetrahydronaphthylene-1 : 4-diamine.

These results indicate that although *ar*-tetrahydro-α-naphthylamine resembles α-naphthylamine in forming para-azo-compounds with greater facility than a benzenoid amine, yet its para-substituted derivatives, unlike those of α-naphthylamine, do not yield ortho-azo-compounds, and in this respect behave like *p*-bromoaniline and other similarly substituted bases of the benzene series.

*76. "Studies in the tetrahydronaphthalene series. Part II. Halogen derivatives of *ar*-tetrahydro-β-naphthylamine." By Clarence Smith.

In a previous paper (*Trans.*, 1902, 81, 900), it was shown that *ar*-tetrahydro-β-naphthylamine resembles primary benzenoid amines in giving diazoamino-compounds, and this resemblance is exemplified further in its behaviour towards the halogens.

Aceto-β-naphthalide yields only 1-bromoaceto-β-naphthalide at the ordinary temperature, even with excess of bromine. *ar*-Tetrahydroaceto-β-naphthalide reacts with one molecular proportion of bromine to form two compounds, namely, 1-bromo-*ar*-tetrahydroaceto-β-naphthalide and 4-bromo-*ar*-tetrahydroaceto-β-naphthalide.

The following compounds have been prepared:

1-*Bromotetrahydronaphthalene*, $C_{10}H_{11}Br$, obtained from *ar*-tetrahydro-α-naphthylamine by the Sandmeyer reaction, is a colourless, refractive liquid with an odour resembling that of halogen compounds of the benzene series; it is volatile in steam and dissolves readily in organic solvents (b. p. 255—257°/751 mm.).

2-*Bromotetrahydronaphthalene*, prepared from *ar*-tetrahydro-β-naphthylamine, resembles the preceding compound and boils at 238—239° under 758 mm. pressure.

1-*Bromo*-ar-*tetrahydroaceto-β-naphthalide*, $C_{12}H_{14}ONBr$, resulting from the action of one molecular proportion of bromine on an equivalent quantity of *ar*-tetrahydroaceto-β-naphthalide dissolved in glacial acetic acid, separates from alcohol in colourless, octahedral crystals (m. p. 125·5°).

4-*Bromo*-ar-*tetrahydroaceto-β-naphthalide*, obtained from the mother liquor in the preparation of the preceding isomeric 1-bromo-compound, separates from alcohol in colourless needles (m. p. 151°).

1-*Bromo*-ar-*tetrahydro-β-naphthylamine*, $C_{10}H_{12}NBr$, is prepared by hydrolysing the corresponding acetyl derivative; it separates from light petroleum in colourless, silky needles (m. p. 52·5°). It dissolves easily in alcohol or acetone, and is volatile in steam.

4-*Bromo*-ar-*tetrahydro-β-naphthylamine* crystallises from light petroleum in colourless needles (m. p. 52°); it is not readily volatile in steam.

*77. "Studies in the tetrahydronaphthalene series. Part III. Reaction between *ar*-tetrahydro-β-naphthylamine and formaldehyde." By Clarence Smith.

Evidence of the benzenoid nature of *ar*-tetrahydro-β-naphthylamine is obtained from the study of the behaviour of the base towards formaldehyde. The product is methylene-*ar*-tetrahydro-β-naphthylamine, analogous to methyleneaniline. There is no tendency to produce an acridine, which would be evidence of its naphthalenoid character.

The following compounds have been prepared:

Methylene-ar-*tetrahydro-β-naphthylamine*, $(C_{11}H_{13}N)_3$, is obtained together with a polymeric modification, $(C_{11}H_{13}N)_x$, when a solution of formaldehyde is added slowly to *ar*-tetrahydro-β-naphthylamine. The trimolecular form separates from acetone or light petroleum as a felted mass of small, white needles; it melts at 121° and gives an intense blood-red coloration with glacial acetic acid.

The polymeric modification is a white, amorphous powder which, when heated, darkens at 156° and fuses at 164°. It is almost insoluble in acetone, light petroleum or benzene, but dissolves in hot alcohol and becomes converted mainly into the trimolecular form.

Methyl-ar-*tetrahydro-β-naphthylamine*, $C_{10}H_{11}\cdot NH\cdot CH_3$, obtained by the reduction of methylene-*ar*-tetrahydro-β-naphthylamine by sodium and amyl alcohol, is a colourless, refractive, oily liquid which boils at 267·5° under 210 mm. pressure. The *hydrochloride*, $C_{11}H_{15}N,HCl$, crystallises from water in white needles. The *nitrate*, $C_{10}H_{15}N,HNO_3$, separates in needles when an ethereal solution of the base is shaken with dilute nitric acid. The *nitrosoamine*, $C_{10}H_{11}N(CH_3)\cdot NO$, is a yellow oil, which gives Liebermann's reaction.

78. "Note on the hydrolysis of starch by diastase." By John Simpson Ford.

The writer finds that Kjeldahl's "law of proportionality" is true for the diastase of barley and air-dried malt, as well as for that of kiln-dried malt.

79. "The resin acids of the *Coniferæ*. Part I. The constitution of abietic acid." By Thomas Hill Easterfield and George Bagley.

The resin acids of the *Coniferæ* as a class have the following points in common: (1) they readily become superfused, and then set to a resin or glass, which crystallises if fused and maintained for some time at a temperature slightly above the initial melting point; (2) they nitrate without difficulty in glacial acetic acid solution; (3) in a fused state, they readily absorb oxygen from the air; (4) their esterification velocity is extremely low; (5) with hydriodic acid, they yield hydrocarbons of nearly the same composition as the diterpenes, with which they have erroneously been regarded as identical.

Colophony, on distillation under diminished pressure or in superheated steam, yields a product which gives analytical results agreeing accurately with those required for abietic acid (m. p. 160—165°).

By the slow distillation of abietic acid, even under reduced pressure, a hydrocarbon, $C_{18}H_{28}$, is produced, which is undoubtedly the "colophene" obtained by Deville on distilling colophony, but is not the "colophene" which the same author produced by polymerising turpentine by means of sulphuric acid. In order to avoid ambiguity, the name "abietene" is proposed for the compound derived from abietic acid.

Krämer and Spilker, by distilling colophony under pressure, obtained a hydrocarbon to which they assigned the formula $C_{18}H_{28}$, regarding it as being derived from abietic acid by the loss of carbon dioxide.

Abietene, $C_{18}H_{28}$, boils at 199—200° (13 mm.), 247—250° (82 mm.), 340—345° (760 mm.), has a sp. gr. 0·973 at 19°/19°, and n_D 1·537 at

20°; it is thus identical with the "diterebenthyl" ($C_{20}H_{30}$?) which Renard (*Compt. rend.*, 1887, **105**, 865) isolated from resin oil.

Abietene is produced when abietic acid is heated with fuming hydriodic acid at 200°; the gases formed at the same time have been analysed and were found to consist of 90 per cent. of carbon monoxide and dioxide approximately in the ratio $9CO : 1CO_2$, the volume of oxides of carbon formed after 2 hours' heating being 80 per cent. of that required for the elimination of one carboxyl group from abietic acid.

Abietene, when distilled with one-third of its weight of sulphur, yields a small quantity of retene (m. p. 99°), but with twice this proportion of sulphur an isomeric hydrocarbon is obtained melting at 86°; at the same time, a hydrocarbon boiling at 330—360° (30 mm.) is produced, which is still under examination. If the distillation with sulphur is conducted under reduced pressure, retene is the principal product. These two hydrocarbons are also formed by distilling Merck's "retene puriss." with one-fifth of its weight of sulphur.

The foregoing observations support the view that hydrogenated retenes are probably normal constituents of resin oil (*Ber.*, 1889, **22**, 3368; 1903, **36**, 647), and that resin oil is undoubtedly a hydrogenated retene.

This conclusion is further strengthened by the observation that abietene, when reduced with hydriodic acid and excess of phosphorus at 240°, takes up two atoms of hydrogen and yields a hydrocarbon, dihydroabietene, which appears to be identical with the dodecahydroretene obtained by Liebermann and Spiegel (*Ber.*, 1889, **22**, 779) by reducing retene under similar circumstances.

The above observations lead to the conclusion that abietic acid is decahydroretenecarboxylic acid, but the accepted formula for retene would not account for its low esterification velocity. There is, however, no experimental evidence for the assumed para-position of the methyl and *iso*propyl groups in retene. That these groups are really in the meta-position in abietic acid and in retene is rendered probable by the observation of Kolbe (*Ber.*, 1880, **13**, 888) that resin spirit is rich in *m*-cymene, but contains only small quantities of ordinary cymene.

80. "The additive products of benzylideneaniline with ethyl acetoacetate and ethyl methylacetoacetate." By Francis Ernest Francis and Miss Millicent Taylor.

It was shown that the additive product of benzylideneaniline and ethyl methylacetoacetate exists in one form only, being unaffected in solution by traces of either piperidine or sodium ethoxide. This confirms Schiff's view of the constitution of such substances. The various data in connection with the additive products from ethyl acetoacetate and benzylideneaniline were indicated, and Morrell and Bellars' work on the subject was criticised.

81. "Studies on ethyl carboxyglutarate. Part I. Action of halogens on ethyl sodiocarboxyglutarate." By Oswald Silberrad and Thomas Hill Easterfield.

When halogens were allowed to act on ethyl sodiocarboxyglutarate, no condensation occurred, but instead of ethyl carboxydiglutarate the haloid derivatives of the original ethyl carboxyglutarate were formed. The reaction may be thus represented:

$$C_2H_5{\cdot}CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}CNa(CO_2{\cdot}C_2H_5)_2 + I_2 = NaI + C_2H_5{\cdot}CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}CI(CO_2{\cdot}C_2H_5)_2$$

The products proved to be identical with the compounds subsequently obtained by the direct halogenation of ethyl carboxyglutarate.

82. "Studies on optically active carbimides. Part I." By Allen Neville and Robert Howson Pickard.

The authors have investigated (i) the preparation of some optically active carbimides, (ii) the use of such compounds for the resolution of synthetical alcohols and amines containing asymmetric carbon atoms, (iii) the measurement of the velocity of reaction between such compounds and various alcohols and amines with the object of contrasting the influence of (1) the constitution of the alcohols and amines, (2) the temperature, (3) the solvents, and (4) various catalytic agents on the velocity of such reactions.

The compounds described were: bornylcarbimide (compare Forster and Attwell, this vol., p. 91), *ethyl bornylcarbamate* and *dibornylcarbamide*, l-*menthylcarbimide*, *methyl ethyl* and *propyl* l-*menthylcarbamates*, and *di*-l-*menthylcarbamide*.

83. "The comparison of the rotation values of methyl, ethyl, and *n*-propyl tartrates at different temperatures." By Thomas Stewart Patterson.

Methyl tartrate was first shown to be capable of existence in a solid form melting at 61·5°.

Data for the variation of rotation with change of temperature of methyl, ethyl, and propyl tartrates were given. Comparisons of the rotation values of these substances at identical temperatures were shown to be of little value, especially at low temperatures. Since, however, the rotation of methyl tartrate vanishes at 0°, that of ethyl tartrate probably at $-34°$, and that of propyl tartrate probably at $-60°$, it may be assumed that the three substances are in corresponding optical conditions at these temperatures, and, in general, methyl tartrate at T°, ethyl tartrate at $(T-34°)$, and propyl tartrate at $(T-60°)$ will also be in corresponding conditions as regards rotation. It is shown that comparisons of rotation effected at corresponding temperatures are much more satisfactory than those obtained for identical temperatures, and that if the rotations are taken at corresponding temperatures, the increment of $2CH_2$ in passing from methyl to ethyl tartrate rather more than doubles the rotation, whilst the next increment of $2CH_2$ in passing to propyl tartrate increases the rotation to 1·41 times that of ethyl tartrate. The rotation of propyl tartrate is therefore almost three times that of methyl tartrate. These results hold within wide limits of temperature.

84. "Note on the action of hydrogen sulphide on formaldehyde and acetaldehyde solutions." By Julien Drugman and William Ernest Stockings.

Although the conditions under which various thio-derivatives are formed when hydrogen sulphide reacts with aqueous solutions of formaldehyde and acetaldehyde respectively have been thoroughly investigated by Hofmann (*Ber.*, 1868, 1, 176; 1869, 2, 152; 1870, 3, 584), Pinner (*Ber.*, 1871, 4, 257), Klinger (*Ber.*, 1876, 9, 1894; 1877, 10, 1879; 1878, 11, 1023), Baumann and Fromm (*Ber.*, 1889, 22, 2600; 1890, 23, 69; 1891, 24, 1434, 1457) and others, it is not generally known that provided hydrochloric acid or other strong mineral acid is absent, the reaction affords a sure means of detecting formaldehyde, even in the presence of acetaldehyde or other higher fatty aldehydes.

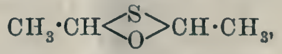
(1) When a dilute aqueous solution of formaldehyde is saturated with hydrogen sulphide in the absence of hydrochloric acid, and the test-tube set aside in a warm place (30—50°), no visible change occurs for about 3 or 4 hours, but afterwards a white, amorphous, flocculent precipitate is gradually deposited. This substance, when dried in a desiccator over sulphuric acid, melts, with decomposition, between 85° and 110°.

This characteristic thio-derivative is precipitated from formaldehyde solution by hydrogen sulphide even in the presence of acetaldehyde, methyl and ethyl alcohols, acetone, or acetic acid; the melting point of the product formed in presence of acetone or acetic acid is fairly definite, namely, 98—103°, and sometimes quite sharp at 98°. According to Baumann (*loc. cit.*), the compound has the composition $3(CH_2S),CH_2O$; it is distinguished from the odourless, crystalline trithioformaldehyde, $(CH_2S)_3$, both by its lower melting point and strong odour. The presence of even 0·1 per cent. of formaldehyde in aqueous solution may be easily detected by means of this reaction.

(2) The crystalline trithioformaldehyde, $(CH_2S)_3$, first prepared by Girard by the reduction of carbon disulphide by means of nascent hydrogen (*Compt. rend.*, 1870, **70**, 623), and afterwards fully investigated by Hofmann (*loc. cit.*), results when hydrogen sulphide acts on a solution of formaldehyde previously strongly acidified with hydrochloric acid. The crude product melts indefinitely between 180° and 205°, but it crystallises from hot acetone in white needles which melt at 216°.

(3) When a solution of acetaldehyde is saturated with hydrogen sulphide in the absence of hydrochloric acid or other strong mineral acid, and the test-tube set aside in a warm place, the liquid soon assumes a milky appearance, owing to the separation of minute, oily particles, which gradually collect in drops on the bottom and sides of the test-tube, leaving the rest of the liquid perfectly clear and translucent. No solid product is ever obtained under these conditions, a circumstance which at once differentiates the behaviour of acetaldehyde from that of formaldehyde.

(4) Several distinct crystalline thio-derivatives can be obtained by the action of hydrogen sulphide on aqueous or alcoholic solutions of acetaldehyde previously acidified with hydrochloric acid. Among these may be mentioned the volatile bimolecular compound,



$$CH_3\cdot CH<\begin{matrix}S\\O\end{matrix}>CH\cdot CH_3,$$

which melts at 61°, and the α-, β-, and γ-*trithioacetaldehydes*, $(C_2H_4S)_3$, which melt at 101°, 125—126°, and 76° respectively. The character of the products and the relative proportions in which they are formed depend entirely on the experimental conditions. When, however, a dilute (1 to 20 per cent.) aqueous solution of acetaldehyde, acidified with about one-fifth of its volume of strong hydrochloric acid, is saturated with hydrogen sulphide and the test-tube set aside in a beaker over a water-bath kept at 50—60°, a very characteristic and striking phenomenon is observed. At the outset, the liquid assumes the milky appearance described under (3), then gradually becomes clear, and finally, after some hours, a volatile thio-compound sublimes on to the cooler portions of the tube in the form of long, glistening needles, which, after crystallisation from acetone or dilute alcohol, melt at 75—78°. The sublimate is not, however, formed if the original solution contains formaldehyde as well as acetaldehyde. In this case, the mixed thio-compounds separate together from the liquid as a crystalline precipitate. Moreover, if the original solution contains a volatile solvent, such as acetone or alcohol, the sublimate will only appear after the solvent in question has nearly all evaporated.

(5) Aqueous solutions of propaldehyde or *iso*butaldehyde saturated with hydrogen sulphide, without any addition of hydrochloric acid and set aside in a warm place, exhibit a similar behaviour to that of acetaldehyde solutions under the same conditions. The oily thio-compounds obtained soon fall to the bottom of the test-tube, leaving the supernatant liquid quite clear. The presence of hydrochloric acid does not materially alter the character of the appearances observed, except in the case of *iso*butaldehyde when, after a very long time, a slight crystalline sublimate may be formed.

85. "The viscosity of liquid mixtures." By Albert Ernest Dunstan.

The following conclusions were drawn from the author's investigation on the viscosity of liquid mixtures:

(1) Aqueous solutions give abnormal results. This is true for all known cases, which, however, are always solutions of two associated liquids, as, for example, alcohol and water.

(2) Wherever chemical affinity is existent to any marked extent in the two liquids of a mixture, abnormal results occur. In many such cases, definite complexes have been isolated.

(3) Wherever marked abnormalities present themselves, it is noted that they do so near points of definite molecular composition, but these points of abnormality are not constant, and shift with change of temperature. At a sufficiently high temperature, they would probably vanish, as then no formation of complexes would be possible.

(4) When points of minima are obtained in the viscosity curve, it is difficult to say whether association or dissociation is proceeding. It certainly seems due to some change in molecular aggregation.

(5) Substances containing the hydroxyl group (and associated) have a higher viscosity, as a rule, than monomolecular substances. Hence the rise of viscosity in the case of alcohol—water is probably due to the formation of complexes.

A further examination of hydroxylic substances is in progress.

86. "The conversion of *iso*propyl alcohol into *iso*propyl ether by sulphuric acid." By Frank Southerden.

In the course of some experiments on etherification by the agency of small quantities of sulphuric acid at high temperatures, it has been found possible to prepare *iso*propyl ether. The yield is very poor, and therefore without improved conditions the method cannot be said to compete with that involving the use of alkyl iodide (Erlenmeyer, *Annalen*, 1863, **126**, 305), but it is interesting as an example of the production of a secondary ether from its alcohol.

Previous observers have obtained only propylene in this reaction. When, however, 3 c.c. of H_2SO_4 were employed for 100 c.c. of *iso*propyl alcohol (b. p. 81—83°), and the mixture heated for 6—12 hours at 150—160°, the ether was formed along with propylene. After removal of the unchanged alcohol by prolonged treatment with sodium, the whole distilled at 70—70·5° (uncorr.). Zander (*Annalen*, 1882, **214**, 164) gives 68·5—69° as the boiling point of the ether. The *iso*propyl ether has an intense odour resembling peppermint; bromine in carbon tetrachloride solution is not decolorised by it. Two vapour density determinations obtained by Victor Meyer's method gave 51·3 and 51·4 whereas the calculated value for $(C_3H_7)_2O$ is 51.

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Merrill, Elmer D. A dictionary of the plant names of the Philippine Islands. pp. 193. Manila 1903. From the Author.

Muir, M. M. Pattison. The elements of chemistry. pp. 554. ill. London 1904. From the Author.

Pictet, Amé. The vegetable alkaloids, with particular reference to their chemical constitution. From the second French edition, rendered into English, revised and enlarged by H. C. Biddle. pp. 505. New York 1904. From the Publishers.

Schmatolla, Otto. Neue Entdeckungen aus dem Gebiete der Chemie und Physik. Die unbegrenzte Teilbarkeit der Masse, der Aufbau der Körper. pp. 84. Berlin 1904. From the Author.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome I., 1, and III., 1. pp. ix + 528, 672. ill. Paris 1904. From Professor H. Moissan.

Pamphlets.

Brough, Bennett H. Cantor lectures on the mining of non-metallic minerals, delivered before the Society of Arts, November and December, 1903. pp. 48. ill. London 1904.

Bürgi, R. T. Der Elektronäther. Beiträge zu einer Neuen Theorie der Elektrizität und Chemie. pp. 47. Berlin 1904.

Dymond, T. S., and Bull, B. W. Variation in the milk of a dairy herd during the summer months. Chelmsford, Essex 1904.

Kunz, George F., and Baskerville, Charles. The action of radium, actinium, Roentgen rays, and ultra-violet light on minerals and gems. (From *Science*, N.S., 18.)

Long, J. H. The electrical conductivity of urine in relation to its chemical composition. Part II. The conductivity of mixed solutions. (From the *J. Amer. Chem. Soc.*, 26.)

Richards, Theodore William, and Stull, Wilfred Newsome. New method for determining compressibility. pp. 45. ill. Washington 1903.

Senier, Alfred. On acridines. Abstract of a paper read before the British Association, Southport meeting, 1903. (From the *Chemical News*, 88.)

ERRATA.

Proc., 1904, Vol. 20.

Page.	Line.	
88	14	*for* "$[\alpha]_D$" *read* "α_D."
88	20	*delete* "veratric acid."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on **Wednesday**, May 18th, 1904, at **5.30** p.m., the following papers will be communicated:

"Action of nitrosyl chloride on pinene." By W. A. Tilden.

"The electrolytic estimation of minute quantities of arsenic." By H. J. S. Sand and J. E. Hackford.

"The decomposition of the alkylureas. A preliminary note." By C. E. Fawsitt.

"The action of sodium methoxide and its homologues on benzophenone chloride and benzylidene chloride. Part II." By J. E. Mackenzie and A. F. Joseph.

"The formation of periodides in nitrobenzene solution. II. Periodides of the alkali and alkaline earth metals." By H. M. Dawson and Miss E. E. Goodson.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 281.

Wednesday, May 18th, 1904. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Before entering on the ordinary business of the meeting, the President said he thought it would be consonant with the wishes of the Fellows if he gave expression to the deep feeling of regret with which they had all received the news of the death of one of the most eminent of their past Presidents, Professor Williamson. A man of philosophic mind and great intellectual activity, he had been led in the later years of his life to abandon research in connection with chemistry in favour of other pursuits. Hence it was difficult for chemists of the present generation to realise how great had been the influence exercised by his experimental researches and his writings on the progress of theoretical chemistry forty years ago. Williamson served the Society during many years on the Council, as vice-President, and for two separate periods as President. The Society had, of course, been represented at the funeral, at which many past and present officers of the Society—including himself and the Treasurer—had assembled, and a resolution of condolence with the family had that day been passed at the meeting of the Council.

Messrs. N. J. Bluman, J. C. Evans, G. Pinchbeck, and M. W. Stevens were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Frank Harold Lowe, B.Sc., 59A, Fulham Park Gardens, S.W.
Henry Stanley Shelton, 4, Larden Road, Acton Vale, W.
Herbert Jenkins, 52, Criffel Avenue, Streatham Hill, S.W.
Rudolf Lessing, Ph.D., 31, Brunswick Square, W.C.
Robert Rodger, 54, Rostrevor Road, S.W.
William Edward Oakden, 2, Gledhow Terrace, South Kensington, S.W.
Charles John Sawer, 6, Cleveland Road, Brighton.

A ballot for the election of Honorary and Foreign members was held, and the following were subsequently declared duly elected:

Prof. Antoine Henri Becquerel.
Prof. Cornelis Adriaan Lobry de Bruyn.
Prof. Frank Wigglesworth Clarke.
Madame Marie Curie.
Prof. Carl Theodor Liebermann.
Prof. Edward Williams Morley.

In reply to Prof. Divers, the President stated that Counsel's opinion had been taken on the question whether women were eligible for election as ordinary Fellows of the Society under the present Charter, and that the opinion was adverse.

*87. "The action of nitrosyl chloride on pinene." By William Augustus Tilden.

Pinene nitrosochloride having been shown by von Baeyer to have the double formula $(C_{10}H_{16}\cdot NOCl)_2$, it occurred to the author that the unsatisfactory yield of this compound by the usual processes might be improved by using a mixture of equal quantities of *d*- and *l*-pinenes which is optically inactive. Whereas previously the yield of nitrosochloride from ordinary *d*-pinene was about 32 per cent. of the pinene, and the product from the more highly rotatory pinene obtained from French turpentine was still less, the employment of a mixture prepared so as to be optically inactive gives 55 per cent.

The melting point of pure pinene nitrosochloride is not 103°, as originally given, but 115° (*circa*). Attempts to resolve pinylamine into two optically active bases proved unsuccessful.

For the regeneration of pinene from the nitrosochloride, methylaniline is recommended in preference to aniline, as there is no violent action and the yield of pinene is greater.

Finally, it is shown that when the nitrosochloride is converted into nitrosocyanide (Tilden and Burrows, *Proc.*, 1902, 18, 161) or into the piperidylnitrolamine, the compound becomes monomolecular at the same time that the nitroso-group assumes the *iso*nitroso- or oxime structure.

DISCUSSION.

Professor MELDOLA suggested that the base produced by the action of dimethylaniline on pinene nitrosochloride might be Bindschedler's green resulting from the secondary interaction between nitrosodimethylaniline and the excess of dimethylaniline present under the conditions of the experiment (*Ber.*, 1883, 16, 864).

*88. "The electrolytic estimation of minute quantities of arsenic." By Henry Julius Salmon Sand and John Edward Hackford.

A high supertension of the cathode is requisite for the reduction of arsenic acid to metallic arsenic, the reaction being most readily effected in the presence of metals having this property, such as lead or zinc and probably also mercury. Platinum, having a low supertension, is quite inefficient.

The production of arsenic trihydride from arsenites is accomplished more readily by platinum cathodes than by those of copper, which have a much higher supertension. In this case, mercury, with an extremely high supertension, is quite unsuitable. A certain amount of supertension, however, appears to be necessary, for platinised platinum with no supertension is inefficient.

The authors recommend the use of lead electrodes for the estimation of minute quantities of arsenic as their application causes a simplification of previous methods. Errors which may arise in the electrolytic methods owing to the presence of foreign metals can be rectified by the addition of lead acetate or zinc sulphate to the electrolyte except when the foreign metal is mercury. When lead and zinc cathodes are used, the smallest amount of arsenic which can be detected in alkaline solutions of arsenates and arsenites is about thirty times as great as in acid solution, but platinum cathodes are quite unsuitable.

DISCUSSION.

Dr. F. M. PERKIN remarked that although the electrolytic apparatus gave good results even with very minute quantities of arsenic, it was, however, a great advantage to have an apparatus in which lead was employed for the cathode instead of the very expensive platinum. The fact that a mercury cathode did not give good results, although there was considerable over-voltage, was due to the formation of an arsenic amalgam, which then escaped the reducing action of the hydrogen. An aluminium cathode is suitable for dilute sulphuric acid solutions, because in this case there is considerable over-voltage and the metal is very slightly attacked, and is, moreover, free from arsenic.

Had nickel electrodes been tried in an alkaline solution ?

The only drawback to the electrolytic method for detecting arsenic is the trouble of preparing the mirrors, especially when special standards are made for each substance tested.

Dr. STEVENSON asked what was the authors' evidence that the lead of commerce can be obtained free from arsenic.

Mr. SAND, in reply, said the electrolytic experiments in alkaline solutions had not been found satisfactory, and had, moreover, not been tried in the case of nickel.

The preparation of mirrors for each kind of material examined was not absolutely necessary, but, nevertheless, this precaution rendered the comparisons more certain.

Several grams of commercial lead had been examined for arsenic with a negative result. The lead most frequently used for cathodes was purest assay lead, whereas pure commercial lead was employed for anodes. New electrodes often contain a small amount of arsenic on the surface, but in all cases they were tested by blank experiments.

*89. "The action of sodium methoxide and its homologues on benzophenone chloride and benzylidene chloride. Part II." By John Edwin Mackenzie and Alfred Francis Joseph.

The authors have found that benzhydrol is formed in the preparation of di*iso*propyloxy-, di*iso*butyloxy-, and di*iso*amyloxy-diphenylmethanes by the action of the respective sodium alkyloxides on benzophenone chloride (compare Trans., 1901, 79, 1204). It is also shown that dibenzoxydiphenylmethane, like its homologues, readily splits up into benzophenone and dibenzyl oxide.

The anhydride of phenyldi-β-hydroxynaphthylmethane has been obtained by the action of benzylidene chloride on β-naphthol, and found to agree in properties with the substance prepared by Claisen (*Annalen*, 1887, 237, 261) from benzaldehyde and β-naphthol. This product was also obtained when the reaction was carried out in xylene solution and when sodium naphthoxide was used instead of naphthol. Claisen's dihydroxy-compound could not be isolated.

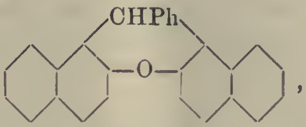
Nitration experiments on the anhydride led to the formation of substances containing from two to six nitro-groups.

When treated with fuming sulphuric acid, the anhydride yielded a

β-naphtholdisulphonic acid, but concentrated sulphuric acid gave rise to a product dissolving in water to a bright red solution, the colour of which was destroyed by alkalis and restored by acids.

DISCUSSION.

Professor **MELDOLA** said that in his opinion the constitution of Claisen's compound might be more correctly represented by the following formula:



as it was more in harmony with the general properties of β-naphthol that the α-ortho-position, and not the second β-position, should be first attacked.

Dr. **HEWITT** stated that the hydroxylic compound,

$$C_6H_5 \cdot CH(C_{10}H_6 \cdot OH)_2,$$

is easily produced by condensing benzaldehyde and β-naphthol in cold acetic acid solution by the aid of hydrochloric acid, and from this the anhydro-substance can be obtained in good yield by heating with acetic acid in sealed tubes.

The coloration observed on dissolving the anhydride in strong sulphuric acid is probably due to oxidation and formation of a carboxonium salt similar to those already studied by Werner, Fosse, and himself.

Dr. **MACKENZIE** replied that at present he had no decided views in favour of the 2 : 3-structure of the anhydride molecule as against the 1 : 2-configuration; he had not yet obtained any substitution products in support of either of these constitutions.

*90. "The bromination of phenolic compounds." By John Theodore Hewitt, James Kenner, and Harry Silk.

When one molecular proportion of bromine acts on phenol, the character and proportions of the products obtained vary with the conditions under which the reaction is carried out. In aqueous solution, the phenol is apparently not all brominated, some of the bromine being used in forming higher substitution products. Absence of water and presence of a strong mineral acid favours the formation of *p*-bromophenol; the quantity of the para-compound diminishes, however, if sodium acetate is added to a glacial acetic acid solution of phenol before bromination, but is slightly increased by the addition of concentrated sulphuric acid.

If more than one molecular proportion of bromine is added to a solution of phenol in concentrated sulphuric and glacial acetic acids, the second molecule of bromine is utilised very slowly, the sulphuric acid hindering substitution in the ortho-position, but by brominating phenol in excess of 73 per cent. sulphuric acid, the halogen rapidly enters into reaction, and a nearly quantitative yield of 2 : 4-dibromophenol is obtained, apparently without any admixture of tribromophenol.

5-Bromosalicylic acid can be conveniently prepared by brominating salicylic acid in a mixture of sulphuric and acetic acids.

4-Bromo-α-naphthol cannot, however, be obtained from α-naphthol under similar conditions, dibromination taking place.

DISCUSSION.

Professor MELDOLA pointed out that in the case of the naphthols it was well known that the first action of bromine is to produce additive products from which hydrogen bromide is expelled by heat. With reference to the influence of temperature as determining the formation of *o*-bromophenol instead of the para-compound, he called attention to Merck's German patent (No. 76597, of 1893), in which it is claimed that by chlorinating or brominating phenol at 150—180° the corresponding halogenated ortho-derivative is produced.

91. "The decomposition of the alkylureas. A preliminary note." By Charles Edward Fawsitt.

The author has already shown (*Zeit. physikal. Chem.*, 1902, **41**, 601) that the decomposition of urea by acids is not a case of ordinary hydrolysis, but is the result of a secondary decomposition, following an isomeric transformation into ammonium cyanate. An investigation of the velocity of decomposition of the alkylureas with acids by similar methods shows an exact parallel with the case of urea. The hydrolysis is indirect, and is effected as a secondary reaction of the acid with the alkylammonium cyanate. Methylurea is decomposed more slowly than urea, but dimethylurea much more rapidly.

*92. "The formation of periodides in nitrobenzene solution. Part II. Periodides of the alkali and alkaline earth metals." By Harry Medforth Dawson and Ethel Elizabeth Goodson.

Previous experiments relating to the nature of the periodides which are formed in nitrobenzene solutions containing iodine and potassium iodide (Dawson and Gawler, Trans., 1902, 81, 524) have been extended to the iodides of the other alkali metals, and to those of the alkaline earth metals, and ammonium and substituted ammoniums. In general, these iodides have properties similar to those of the potassium derivative, and the experimental data indicate that enneaiodides of the type $M'I_9$ or $M''I_{18}$, which are the essential components of such solutions when saturated with iodine, probably represent the highest limiting type of periodide, for the solvent used in these experiments appears to be specially suited to the formation of such periodides, and saturation of the solution with iodine favours the formation of the most complex product.

In the case of certain substituted ammonium radicles, enneaiodides have been already isolated and the analogous behaviour of the alkali and alkaline earth metals indicates the possibility of preparing enneaiodides of these metals under favourable conditions.

Periodides are also formed by the bromides of the alkali metals in nitrobenzene solution and to a small extent by the chlorides.

Compounds of lithium iodide with nitrobenzene and *o*-nitrotoluene, and of sodium penta-iodide with nitrobenzene have been isolated.

93. "The action of ozone on ethane. Preliminary note." By William Arthur Bone and Julien Drugman.

The authors have obtained ethyl alcohol by the interaction of ethane and ozone at 100°. Two experiments have been carried out as follows: ethane and ozonised air (O_3 = about $2\frac{1}{2}$ per cent.) were separately led into the top of a vertical, wide glass tube, about 18 inches long, packed with glass beads and heated by a steam jacket. The proportions of the gases were so regulated that the ethane was always present in large excess, under which conditions the ozone entirely disappeared as the mixture slowly descended the tube. The gases were then drawn through a series of cooled glass worms containing water for the absorption of soluble intermediate products. Each experiment extended over 3 or 4 days, during which about 5 litres of ethane and 13 to 15 litres of the ozonised air passed through the apparatus. Subsequent examination of the liquid from the coolers showed that it contained ethyl alcohol, acetaldehyde, and traces of formaldehyde. The presence of ethyl alcohol was proved by first oxidising the aldehydes by means of an excess of an ammoniacal silver solution at the ordinary temperature (1 hour), then acidifying the liquid with dilute sulphuric acid and submitting it to distillation in steam. The distillate in each case at once gave the iodoform reaction; the precipitate was composed of microscopic crystals, which slowly formed the characteristic star-like aggregates. As a precaution, the absence of acetaldehyde from the distillate was proved by the negative result obtained with Schiff's reagent. An examination of the gaseous products showed that they did not contain acetylene, ethylene, or free hydrogen.

There can be but little doubt, therefore, that ethyl alcohol is the primary product in the slow combustion of ethane. At temperatures where ethane begins to react with oxygen with appreciable velocity, the alcohol is oxidised so many times faster that it is practically impossible actually to detect its formation (compare Bone and Stockings, this vol., p. 106). The authors propose to continue the experiments, and to extend them to ethylene, acetylene, and other typical hydrocarbons.

94. "Caproylthiocarbimide." By Augustus Edward Dixon.

Caproyl chloride, dissolved in benzene, interacts spontaneously with finely-powdered ammonium thiocyanate, yielding *caproylthiocarbimide*, $C_5H_{11}\cdot CO\cdot NCS$; b. p. 108°/23 mm.; sp. gr. = 1·0165 at 18°/15°. This liquid is slowly hydrolysed by boiling water into caproic and thiocyanic acids; when heated with an alkaline lead salt, it yields metallic sulphide, together with thiocyanate, and is readily desulphurised by ammoniacal silver nitrate. If brought into contact with primary and secondary amines, direct union occurs, with formation of the corresponding thiocarbamides.

ab-*Caproylphenylthiocarbamide*, $C_5H_{11}\cdot CO\cdot NH\cdot CS\cdot NHPh$, separates from alcohol in felted masses of needles, melting at 77—78° without decomposition; when dissolved in hot dilute caustic alkali, the caproyl group is removed, leaving phenylthiourea.

ab-*Caproyl*-o-*tolylthiocarbamide* melts at 97—98° and generally resembles the phenyl compound. When treated in hot alcoholic solution with the calculated quantity of silver nitrate, it yields the corresponding ab-*caproyl*-o-*tolylurea* (m. p. 99—100°). ab-*Caproyl*-p-*tolythiocarbamide* (m. p. 90—91°), when treated with silver nitrate, yields *caproyl*-p-*tolylurea*, melting at 131—132° (corr.).

n-*Caproylphenylbenzylthiourea*, $C_5H_{11}\cdot CO\cdot N{:}C(SH)\cdot NBzPh$, was obtained from benzylaniline and the thiocarbimide; it separated from alcohol in vitreous prisms melting at 77—78°, and was not affected by boiling with neutral or ammoniacal silver nitrate; when boiled with caustic alkali, the caproyl group is eliminated, leaving a residue which can be desulphurised by an alkaline solution of lead.

Since, by interaction with water, the parent oil gives thiocyanic acid instead of carbon oxysulphide, its behaviour in these circumstances must be accounted that of a thiocyanate; on the other hand, the power to combine with nitrogenous bases, thereby yielding substituted thiocarbamides, places it among the *iso*thiocyanates. This dual capacity is in accordance with the view developed in earlier papers by the author (*Trans.*, 1901, **79**, 542 ; this vol. p. 350), that a variety of tautomerism subsists amongst the thiocyanates of electro-negative radicles, the characteristic sulphuretted group of which may act either as ·SCN or ·NCS. Moreover, in certain cases, both forms appear to be simultaneously active (Doran, *Proc.*, 1904, **20**, 20), the preponderance of one or other depending almost entirely on the temperature at which interaction is caused to take place.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Caro, N., Ludwig, A., und Vogel, J. H. Handbuch für Acetylen in technischer und wissenschaftlicher Hinsicht. Herausgegeben von J. H. Vogel. pp. xiv + 880. ill. Braunschweig 1904.

Noelting, E., und Lehne, A. Anilinschwarz und seine Anwendung in Färberei und Zeugdruck. Zweite Auflage. pp. 178. ill. Berlin 1904.

Ostwald, Wilhelm. Grundlinien der anorganischen Chemie. Zweite Auflage. pp. xx + 808. ill. Leipzig 1904.

Ostwald, Wilhelm. Malerbriefe, Beiträge zur Theorie und Praxis der Malerei. pp. viii + 165. Leipzig 1904.

Spaeth, Eduard. Die chemische und mikroskopische Untersuchung des Harnes. pp. xx + 532. ill. Leipzig 1903.

III. *Pamphlets.*

Beach, S. A., Clark, V. A., and Taylor, O. M. Spray mixtures and spray machinery. (New York Agric. Exper. Station. Bulletin No. 243.)

Fairley, Thomas. The uses of lime on land. (From the *Annual Report, Yorkshire Agric. Soc.*, 1904.)

Grindley, H. S., and Mojonnier, Timothy. Experiments on losses in cooking meat. (U. S. Dept. of Agriculture, Office of Experiment Stations. Bulletin No. 141.) Washington 1904.

New York Agricultural Experimental Station. Directors' Report for 1903. (Bulletin No. 244.)

Parrot, P. J., Beach, S. A., and Woodworth, H. C. The lime-sulphur-soda wash for orchard treatment. (New York Agric. Exper. Station. Bulletin No. 247.)

Sherman, Penoyer, L. The gutta-percha and rubber of the Philippine Islands. Manila 1903.

Sodeau, William H. The decomposition of chlorates. (From the *Proc. Univ. of Durham Phil. Soc.*, 2, pt. 3.)

——The estimation of unburnt products in chimney gases by means of a modified Orsat apparatus. (From the *Chemical News*, 89.)

Taylor, O. M., and Clark, V. A. An experiment in shading strawberries. (New York Agric. Exper. Station. Bulletin No. 246.)

Van Slyke, L. L., and Hart, E. B. Chemical changes in the souring of milk and their relations to cottage cheese. (New York Agric. Exper. Station. Bulletin No. 245.)

Wheeler, W. P. The importance of mineral matter and the value of grit for chicks. (New York Agric. Exper. Station. Bulletin No. 242.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 6th.

At the next Ordinary Meeting, on Thursday, June 2nd, 1904, at 8 p.m., the following papers will be communicated:

"*iso*Nitrosocamphor." By M. O. Forster.

"Imino-ethers and allied compounds corresponding with the substituted oxamic esters." By G. D. Lander.

"The action of heat on α-hydroxycarboxylic acids. Part I. α-Hydroxystearic acid." By H. R. Le Sueur.

"The basic properties of oxygen. Additive derivatives of the halogen acids and organic compounds and the higher valencies of oxygen. Asymmetric oxygen." By E. H. Archibald and D. McIntosh.

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Issued 11/6/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 282.

Thursday, June 2nd, 1904. Dr. W. H. Perkin, F.R.S , Vice-President, in the Chair.

Messrs. T. L. D. Porter and C. Smith were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William Herbert Dalton, 85, Hayter Road, Brixton Hill, S.W.
John Evans, 67, Surrey Street, Sheffield.
Archie Willoughby Henzell, Witton Hall Industrial School, Birmingham.
Arnold Bertram Tonkin, Durban, Natal.
Henry Bridges Weeks, The Retreat, Infield Park, Barrow-in-Furness.

Of the following papers, those marked * were read :

*95. "Imino-ethers and allied compounds corresponding with the substituted oxamic esters." By George Druce Lander.

When piperidine and phenylhydrazine condense in anhydrous media with methyl dichloro-oxalate, the dipiperidide,

$$CO_2Me\cdot C(C_5NH_{10})_2\cdot OMe,$$

and the imino-compound, $CO_2Me\cdot C(OMe){:}N\cdot NHPh$ (m. p. 123—124°), result, as described by Anschütz and Stiepel (*Annalen*, 1899, **306**, 11). The latter substance gives the corresponding acid, which is unstable, yielding, on boiling with aqueous methyl alcohol, carbon dioxide, oxalic acid, and formazan.

With aniline and *p*-toluidine it was not found possible to isolate either the mixed ortho-compounds, $CO_2Me\cdot C(NHR)_2\cdot OMe$, or the imino-ethers, $CO_2Me\cdot C({:}NR)\cdot OMe$, of Anschütz and Stiepel. Diarylamidino-oxalic esters, $CO_2Me\cdot C({:}NR)\cdot NHR$, and small quantities of the corresponding amidinoamides were obtained in the cold, and also in boiling xylene solution, together with substituted oxamates and oxamides, substituted formamidines, carbon dioxide, and methyl chloride.

*Semi-*N*-phenylimino-oxalic dimethyl ether*, $CO_2MeC({:}NPh)\cdot OMe$, a liquid (b. p. 130—132°/12 mm.) prepared by methylating methyl oxanilate by means of silver oxide, resembles the diethyl analogue, (*Trans.*, 1901, **79**, 699). Dry ammonia was found to be without action in the cold on any of the oxalimino-ethers.

The following compounds were described: *methyl phenylmethyloxamate* (b. p. 170—175°/13 mm.); *semi-*N-p*-tolylimino-oxalic diethyl ether* (b. p. 160°/14 mm.); *methyl diphenylamidino-oxalate* (m. p. 65—66°), and the analogous *di-*p*-tolyl methyl ester* (m. p. 103°) and *hyl ester* (m. p. 98—100°).

The *diphenyl-* and *di-*p*-tolyl-amido-oxalic acids* lose carbon dioxide on heating, and change into substituted formamidines,

$$CO_2H\cdot C({:}NR)\cdot NHR \rightarrow CO_2 + HC({:}NR)\cdot NHR,$$

whilst the di-*p*-tolylamidino-ester, on heating, evolves carbon dioxide and yields *di-*p*-tolylmethylformamidine.* The hydrochlorides of the amidino-esters decompose on fusion, giving rise to methyl chloride, carbon dioxide, and formamidines.

Methyl iodide and the di-*p*-tolylamidino-ester give the *methyl ester*, $CO_2Me\cdot C({:}NC_7H_7)\cdot NMe\cdot C_7H_7$ (m. p. 91—92°), the corresponding *acid* decomposing at 80—81° into carbon dioxide and the foregoing di-*p*-tolylmethylformamidine.

*96. "The action of heat on α-hydroxycarboxylic acids. Part I. α-Hydroxystearic acid." By Henry Rondel Le Sueur.

The investigation of the action of heat on α-hydroxystearic acid, briefly described in a preliminary note (*Proc.*, 1904, **19**, 14), has now been completed, and in view of the fact that Blaise (*Compt. rend.*, 1904, **138**, 697) has recently published an account of work of a similar nature, it appears desirable to set forth the results of this investigation.

Margaric aldehyde, $C_{16}H_{33}\cdot CHO$, produced on heating α-hydroxystearic acid, crystallises in needles and melts at 36°; its *oxime* and *semicarbazone* melt at 89·5° and 107—108° respectively. With hydrogen cyanide, it forms *α-hydroxyheptadecyl cyanide* (m. p. 61·5—62·5°), which, on partial hydrolysis, gives *α-hydroxystearamide* melting at 148—149°, and, on complete hydrolysis, α-hydroxystearic acid.

Margaric acid, obtained by oxidation of the above aldehyde with potassium permanganate, melts at 60—61°; its *methyl* and *ethyl* esters melt at 29° and 28° respectively. *α-Bromomargaric acid* crystallises from dilute acetic acid in glistening plates (m. p. 52·5°).

Discussion.

Dr. Lewkowitsch pointed out with regard to the α- and β-hydroxystearic acids obtained from oleic and *iso*oleic acids respectively that the α-compound was not identical with the α-acid described by the author since, on oxidation with chromic acid, it yielded sebacic and ketostearic acids and was probably a κ-acid. It would be of interest to know whether the author's margaric acid was identical with Krafft's margaric acid or with daturic acid; the latter might now be regarded as an acid which could be somewhat easily obtained, since it had been found in lard as the mixed glyceride, daturodistearin.

Dr. Le Sueur, in reply, said that the acid which he had described was probably identical with Krafft's margaric acid, as the two substances melted at practically the same temperature; but, as Krafft had not prepared any characteristic derivatives from this acid, he could not state definitely that they were one and the same substance. These remarks also applied to daturic acid, which melts at 55°.

*97. "Ionisation and chemical combination." By James Wallace Walker.

The assumption that all chemical reaction takes place between pre-existing ions is unsatisfactory in that it is incapable of experimental demonstration. In many reactions, the formation of intermediate compounds points to the conclusion that such changes take place in several stages. Some of these compounds can only exist in virtue of the higher valencies possessed by their constituent atoms. Metathetic reactions between the alkyl halides, which take place with great readiness in presence of aluminium chloride, are described and shown to be due to the formation of such compounds; they are accompanied by the production of ionised solutions, but in an analogous case, where the solution is also ionised, the corresponding reaction is excessively slow. Several series of observations point to the conclusion that ionisation is the result of chemical combination due to potential valency, and that reaction is not dependent in these cases on antecedent ionisation.

The ethers and the alkyl halides are shown to become quite good ionising media when employed in certain reactions in which they are themselves involved, although from their very low dielectric power they would not be expected to have this property. The variation of the molecular conductivity of some of these solutions with varying concentration shows very pronounced maxima and minima, which point to the formation of compounds with the solvent. These maxima and minima correspond in some instances with pronounced colour changes in the solutions. The conclusion is that, in general, combination through the operation of higher valencies precedes ionisation or any other manifestation of chemical change.

*98. "Ionisation and chemical combination in the liquefied halogen hydrides and hydrogen sulphide." By James Wallace Walker, Douglas McIntosh, and Ebenezer Henry Archibald.

A large number of organic substances are shown to yield solutions which are good conductors of an electric current when dissolved in the liquefied halogen hydrides. Nearly all of those containing oxygen form conducting solutions in one or other of these media. In most of these instances, the ionisation can only take place after combination with the solvent. The importance of the existence of such compounds in depicting the mechanism of some of the fundamental reactions of organic chemistry is pointed out in the preceding communication. Hydrogen sulphide, although an exceedingly good solvent for nearly all classes of substances, yields only a few solutions which conduct at all and very few that conduct well. Almost all of these are, however, cases in which chemical combination between solvent and solute may be assumed.

*99. “Some compounds of aluminium chloride with organic substances containing oxygen.” By James Wallace Walker and Arthur Spencer.

Compounds of aluminium chloride with ether, anisole, ethyl benzoate, methyl mandelate, ethyl oxalate, ethyl malonate, acetic acid, *o*-nitrotoluene, and *m*-dinitrobenzene have been prepared in order to determine whether there is a proportionality between the number of atoms of oxygen and the number of molecules of aluminium chloride which enter into combination.

In determining the depression of freezing point of aluminium chloride in *o*-nitrotoluene solution, it was found that this solvent has two crystalline forms, one melting at $-10°$ and the other at $-4·25°$. The molecular weight of the salt apparently increases with increasing volume.

*100. “The constituents of chaulmoogra seeds.” By Frederick Belding Power and Frank Howorth Gornall.

The seeds which afford the chaulmoogra oil of commerce are derived from *Taraktogenos Kurzii* (King), a native of Burmah, and not, as has until quite recently been assumed, from *Gynocardia odorata* (R.Br.). The oil has previously been examined by Moss (*Year-book of Pharmacy*, 1879, 523—533), Petit (*J. Pharm. Chim.*, 1892, **26**, 445), and more recently by Schindelmeiser (*Ber. deutsch. pharm. Ges.*, 1904, **14**, 164), but their results differ in many respects from those obtained by the present authors, which are as follows:

The seeds of *Taraktogenos Kurzii* (King), contain a hydrolytic enzyme, and also an unstable cyanogen compound, which reacts with the enzyme when the seeds are crushed, giving rise to hydrogen cyanide. Numerous attempts were made to isolate this compound, but without success. Further experiments will be made in this direction.

On expression, the seeds yielded 30·9 per cent. of a fatty oil, which had the following constants: m. p. 22—23°; sp. gr. 0·951 at 25° and 0·940 at 45°; $[\alpha]_D^{15°} + 52°$; acid value 23·9; saponification value 213; iodine value 103·2.

On hydrolysis, the fatty oil yielded glycerol, a very small amount of phytosterol, $C_{26}H_{43}·OH$ (m. p. 132°), and a mixture of fatty acids (m. p. 44—45°; $[\alpha]_D$ $+52·6°$ in chloroform; acid value 215; iodine value 103·2), which consisted chiefly of several homologous acids belonging to a series $C_nH_{2n-4}O_2$ containing a closed ring and one ethylenic linking, no member of which has hitherto been isolated from a fatty oil. The highest of these homologues present, which was isolated in a pure condition, separates from most of the usual organic solvents in glistening leaflets (m. p. 68°; b. p. 247—248°/20 mm., $[\alpha]_D + 56°$), has the formula $C_{18}H_{32}O_2$, and is designated *chaulmoogric acid*. It combines with only two atomic proportions of bromine or iodine. Palmitic acid also was identified, and there is reason for assuming the presence of a near homologue or homologues of chaulmoogric acid, but belonging to the series having the general formula $C_nH_{2n-4}O_2$ with two ethylenic linkings. Undecylic acid and hydroxy-acids were proved to be absent, and an individual acid corresponding with hypogæic acid could not be isolated. The "gynocardic acid" of all previous investigators is believed to be a mixture of several substances.

The "press-cake" yielded, besides formic and acetic acids and a very small amount of volatile esters having the characteristic odour of the seeds, an appreciable amount of a neutral oily *substance*, $C_{18}H_{32}O_2$, (b. p. 214—215°/18 mm., sp. gr., 0·9066 at 16°/16°, $[\alpha]_D + 42{\cdot}4°$), which is isomeric with chaulmoogric acid; this substance is being further investigated, as are also the seeds of *Gynocardia odorata* (R.Br.).

*101. "The constitution of chaulmoogric acid. Part I." By Frederick Belding Power and Frank Howorth Gornall.

With the object of ultimately determining the constitution of *chaulmoogric acid*, $C_{18}H_{32}O_2$ (see preceding abstract), a number of its derivatives have been prepared and studied.

Methyl chaulmoograte, $C_{17}H_{31}{\cdot}CO_2Me$ (m. p. 22°, b. p. 227° corr./20 mm., sp. gr. 0·9119 at 25°/25°, $[\alpha]_D^{15°} + 50°$ in chloroform), was prepared by the interaction of the acid, methyl alcohol, and hydrogen chloride. *Ethyl chaulmoograte*, $C_{17}H_{31}{\cdot}CO_2Et$, a colourless oil (b. p. 230° corr./20 mm., sp. gr. 0·9079 at 15°/16°, $[\alpha]_D^{20°} + 50{\cdot}7°$), was prepared in like manner. *Chaulmoogramide*, $C_{17}H_{31}{\cdot}CO{\cdot}NH_2$ (m. p. 106°, $[\alpha]_D^{27°} + 57{\cdot}3°$ in chloroform), was obtained according to Aschan's method (*Ber.*, 1898, 31, 2344). *Bromodihydrochaulmoogric acid*, $C_{17}H_{32}Br{\cdot}CO_2H$ (m. p. 36—38°; optically inactive), is formed when chaulmoogric acid is treated with hydrogen bromide in glacial acetic acid.

Ethyl chaulmoograte absorbs two atomic proportions of bromine in the cold, forming *ethyl dibromodihydrochaulmoograte*, $C_{17}H_{31}Br_2{\cdot}CO_2Et$, which is an oil.

When chaulmoogric acid is treated with sodium in boiling amyl alcohol, the ethylenic linking is not resolved, but there were obtained, after fractional distillation of the product, *chaulmoogryl alcohol*, $C_{18}H_{33}\cdot OH$ (m. p. 36°, $[\alpha]_D$ +58·4°) and *chaulmoogryl chaulmoograte*, $C_{17}H_{31}\cdot CO_2\cdot C_{18}H_{33}$ (m. p. 42°), together with unchanged chaulmoogric acid.

The saturated acid, *dihydrochaulmoogric acid*, $C_{17}H_{33}\cdot CO_2H$ (m. p. 71—72°, b. p. 248°/20 mm.; optically inactive), is formed, however, on reducing bromodihydrochaulmoogric acid with zinc dust and alcohol, or chaulmoogric acid with hydriodic acid and phosphorus. By the latter process, a hydrocarbon, *chaulmoogrene*, $C_{18}H_{34}$ (b. p. 193—194°/20 mm). is also formed. *Methyl dihydrochaulmoograte*, $C_{17}H_{33}\cdot CO_2Me$ (m. p. 26—27°, b. p. 222—223°/20 mm.), was prepared from the corresponding acid.

Chaulmoogric acid is not attacked by fused caustic alkalis even at 300°.

When chaulmoogric acid was oxidised with cold permanganate (1 atom oxygen), *dihydroxydihydrochaulmoogric acid*, $C_{17}H_{31}(OH)_2\cdot CO_2H$ (m. p. 102°), was produced, but when the amount of permanganate was equivalent to 4—5 atomic proportions of oxygen, formic acid and *two dibasic acids* were obtained, the latter having the formulæ $C_{15}H_{28}(CO_2H)_2$ and $C_{15}H_{28}O(CO_2H)_2$ (m. p. 128°). The *ethyl esters* of these acids were described.

The molecular magnetic rotation of ethyl chaulmoograte very closely approximates to the calculated value for an unsaturated ester of the formula $C_{20}H_{36}O_2$, having a closed ring and one ethylenic linking, the latter being contained in an allyl group. This conclusion, based on the magnetic rotation, is in harmony with the results obtained by the oxidation of the acid.

The further investigation of chaulmoogric acid is proceeding.

*102. "Gynocardin, a new cyanogenetic glucoside. Preliminary note." By Frederick Belding Power and Frank Howorth Gornall.

In the course of an examination of the seeds of *Gynocardia odorata* (R.Br.), it was observed that when these were bruised and brought into water a strong odour of hydrogen cyanide is developed. This is due to the presence of a cyanogenetic glucoside, which the authors have isolated in a crystalline state, and designate *gynocardin*. It is very soluble in water, less freely in alcohol, and crystallises from these solvents in colourless needles which melt at 161—162° with slight decomposition, and have $[\alpha]_D^{19°}$ +37·1°; it gave on analysis the following percentages: C = 48·0; H = 5·8; N = 4·3. Its constitution is being determined.

103. "*iso*Nitrosocamphor." By Martin Onslow Forster.

An unstable *iso*nitrosocamphor (m. p. 114°), produced by the action of sodium and amyl nitrite on camphor, is converted into the yellow benzoyl derivative (m. p. 105—106°) on treatment with benzoyl chloride in pyridine, whilst the colourless benzoyl derivative (m. p. 136°) is produced in a similar manner from the stable *iso*nitrosocamphor (m. p. 152°).

Potassium ferricyanide oxidises both forms to an unstable *peroxide*, $C_{20}H_{28}O_4N_2$, which is insoluble in alkalis, and, the more fusible *iso*nitrosocamphor being attacked first, the isomeride can be freed from it by using insufficient oxidising agent.

The O-*methyl ether* of *iso*nitrosocamphor, $C_{11}H_{17}O_2N$, obtained by the action of methyl iodide in presence of silver oxide, crystallises in rectangular plates, melts at 107°, and has $[\alpha]_D + 197 \cdot 7°$. Reduction converts it into aminocamphor, hydrolysis resolves it into α-camphornitrilic acid, and hydroxylamine gives rise to the *oxime*, $C_{11}H_{18}O_2N_2$, which melts at 188° and has $[\alpha]_D - 95 \cdot 3°$.

The N-*methyl ether* of *iso*nitrosocamphor, $C_{11}H_{17}O_2N$, produced in association with the isomeride when methyl iodide acts on *iso*nitrosocamphor dissolved in alcoholic potash, is a pale yellow oil which decomposes on distillation and has $[\alpha]_D + 279 \cdot 8°$. Dilute acids and alkalis hydrolyse the substance to camphorquinone and β-methylhydroxylamine, reduction with zinc dust and acetic acid converting it into methylaminocamphor; hydroxylamine gives rise to *iso*nitrosocamphor and the β-dioxime of camphorquinone, whilst phenylhydrazine transforms it into camphorquinonephenylhydrazone.

The decomposition of the colourless benzoyl derivative of *iso*nitrosocamphor on exposure to light yields the anhydrides of benzoic and α-camphornitrilic acids, the yellow isomeride giving rise to the same products. Determinations of molecular weight reveal no difference between the isomeric benzoyl derivatives.

The following derivatives of the camphorquinone dioximes have been examined. The *acetyl* α-dioxime (m. p. 148—149°), the *dibenzoyl* α-dioxime (m. p. 153°), the *diacetyl* β-dioxime (m. p. 119°), the *dibenzoyl* β-dioxime (m. p. 189°), the *benzoyl* γ-dioxime (m. p. 172°), and the *dibenzoyl* γ-dioxime (m. p. 159°).

104. "The basic properties of oxygen. Additive compounds of the halogen hydrides and organic compounds, and the higher valencies of oxygen. Asymmetric oxygen." By Ebenezer Henry Archibald and Douglas McIntosh.

An account was given of the preparation and properties of a number of compounds in which oxygen assumes a valency higher than two.

The following compounds have been prepared and analysed :

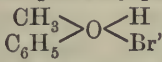
Acetone yields the hydriodide, $(CH_3)_2CO,HI$, the hydrobromide, $(CH_3)_2CO,HBr$, and the hydrochloride, $[(CH_3)_2\cdot CO]_2,5HCl$.

Ether gives rise to the compounds $(C_2H_5)_2O,HI$, $(C_2H_5)_2O,HBr$, and $(C_2H_5)_2O,5HCl$.

Ethyl alcohol furnishes the following series :

$$C_2H_5\cdot OH,2HI,\ C_2H_5\cdot OH,2HBr, \text{ and } C_2H_5\cdot OH,5HCl.$$

These products are white compounds, crystallising readily from their solutions in the liquefied halogen hydrides and melting at temperatures varying between −120° and −9°; they are prepared by mixing together the organic compound previously cooled to −80° with the appropriate halogen hydride in the liquid state, considerable quantities of heat being generated by the reaction.

A compound of anisole and hydrogen bromide has been prepared, which is probably phenylmethyloxonium bromide having the constitution  $\begin{matrix}CH_3\\C_6H_5\end{matrix}\!>O<\!\begin{matrix}H\\Br\end{matrix}$, and therefore containing an asymmetric oxygen atom. This and similar compounds are at present under investigation.

105. "The fermentation of the indigo-plant." By Cyril Bergtheil.

The fermentation of the indigo-plant has been ascribed to a bacterium and also to enzymes, but has hitherto never been satisfactorily investigated. The author shows that, although there are many bacteria capable of producing the fermentation, it is in the main due to a specific enzyme occurring in the plant cells. A very active solution of this enzyme has been obtained, and the course of the fermentation produced by adding this to an extract of the indigo plant made in boiling water has been studied. It is found that the fermentation proceeds in a similar manner to that observed by Adrian Brown for invertase (*Trans.*, 1902, **81**, 273) and by Horace Brown and Glendinning for diastase (*Trans.*, 1902, **81**, 388), namely, that equal quantities of substance are transformed in equal intervals of time in the early stages, but not in the later ones. The point at which the course of the change can no longer be represented by a straight line is when 17 to 20 per cent. of the total action has taken place. The curve representing the reaction ceases to be linear at about the same point when the time factor is kept constant, but the quantity of acting enzyme varied.

The optimum temperature for the action is almost exactly 50°, and the temperature at which the enzyme is destroyed is 71°. The rate of action is decreased by the presence of both acids and alkalis. Sodium acetate up to 1 per cent. does not affect the rate of action. Various antiseptics all produced inhibition, formalin to the greatest, and boracic acid to the least extent. Emulsin can produce the indigo fermentation, but has a very weak action. It is doubtful whether the indigo enzyme can decompose amygdalin. Myrosin cannot ferment an extract of the indigo plant, and the indigo enzyme cannot ferment sinigrin. No evidence of the existence of an oxidase in the indigo plant was obtained.

106. "The union of hydrogen and chlorine. Action of the silent discharge on chlorine." By Joseph William Mellor.

By means of a special apparatus, chlorine can be subjected to any desired treatment before admixture with hydrogen without disturbing the equality of the proportions of hydrogen and chlorine in Bunsen and Roscoe's actinometer. The electrolytic gases are first sent through the liquid in the insolation vessel until a state of equilibrium is attained; the gases are then led into the insolation vessel without bubbling through this liquid at all.

If the chlorine gas is led through a glass "ozone apparatus" before admixture with hydrogen, the period of induction is curtailed, as indicated in the third column of the following table. The numbers in the fourth column were obtained by the same apparatus, but the chlorine was exposed to the light of an acetylene flame before admixture with hydrogen. The numbers in the second column were obtained with chlorine not subjected to any previous treatment.

Time in minutes.	Ordinary chlorine.	Movement of index with (1) chlorine and silent discharge.	Movement of index with (2) chlorine and acetylene light.
1	0·1 cm.	1·8 cm.	2·5 cm.
2	0·1 ,,	4·4* ,,	4·2* ,,
3	0·4 ,,		
4	1·5 ,,		
5	3·0 ,,		
6	4·0* ,,		

The asterisk denotes that the gases afterwards united at a constant rate.

Moist chlorine is more chemically active towards hydrogen when subjected to (i) a preliminary exposure to light; or to (ii) a silent discharge of electricity.

Attempts are being made to isolate the active component.

107. "Studies on ethyl carboxyglutarate. Part II. Action of ethyl bromocarboxyglutarate on ethyl sodiocarboxyglutarate. Formation of ethyl carboxyglutaconate." By Oswald Silberrad and Thomas Hill Easterfield.

It was shown by the authors in the former part of the present work (this vol., 114) that ethyl sodiocarboxyglutarate is converted into haloid derivatives of ethyl carboxyglutarate by the action of halogens, no ethyl carboxydiglutarate being formed. For this reason, the reaction between ethyl bromocarboxyglutarate and ethyl sodiocarboxyglutarate has been examined.

On bringing together the haloid and sodium derivatives of ethyl carboxyglutarate, they react and give rise to a mixture of the original ethyl carboxyglutarate and a new unsaturated ester, $C_{12}H_{18}O_6$. The reaction, which appears to be unlike anything hitherto observed, may be represented as follows:

$$C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CNa(CO_2\cdot C_2H_5)_2 + C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CBr(CO_2\cdot C_2H_5)_2 =$$
$$C_2H_5\cdot CO_2\cdot CH_2\cdot CH_2\cdot CH(CO_2\cdot C_2H_5)_2 + NaBr + C_2H_5\cdot CO_2\cdot CH_2\cdot CH\colon C(CO_2\cdot C_2H_5)_2.$$

This unsaturated ester is thus to be regarded as ethyl α-carboxy-$\Delta^{\alpha\beta}$-glutaconate. On saponification, it yields a new carboxyglutaconic acid, which readily breaks up into glutaconic acid and carbon dioxide:

$$C_3H_3(CO_2\cdot C_2H_5)_3 + 3H_2O = CO_2H\cdot CH_2\cdot CH\colon CH\cdot CO_2H + 3C_2H_5\cdot OH + CO_2,$$

from which it will be seen that its constitution must be represented by one of the following formulæ:

$$\text{I. } C_2H_5\cdot CO_2\cdot CH\colon CH\cdot CH(CO_2\cdot C_2H_5)_2 \text{ or}$$
$$\text{II. } C_2H_5\cdot CO_2\cdot CH_2\cdot CH\colon C(CO_2\cdot C_2H_5)_2.$$

The latter of these formulæ must be the correct one, since the former represents ethyl *iso*aconitate, from which the new isomeride differs in containing no active hydrogen and hence forming no sodium derivative.

108. "The vapour pressures of liquid mixtures of restricted mutual solubility. Preliminary notice." By Arthur Marshall.

Although this subject has been somewhat fully treated from the theoretical side by Margules, Ostwald, Duhem, and others, yet with the exception of some somewhat rough measurements published by Konowaloff in 1881 and by Schreinemakers in 1900, no actual experiments have been made to test their conclusions. Experiments on mixtures of water with ether, methyl acetate, and more especially ethyl methyl ketone, have shown that in each case the curve for the total vapour pressure has much the same shape, but that this form is slightly different to those predicted by the foregoing authors.

When one of these comparatively volatile organic liquids is added gradually to water, the vapour pressure rises rapidly until the water becomes saturated. A second liquid phase then ensues and the curve becomes a horizontal straight line in accordance with the phase rule. When sufficient of the liquid has been added to dissolve the water completely, the curve again rises until it reaches a maximum, after which it falls again, until at 100 per cent. it coincides with the vapour pressure of the pure substance. It is in this portion of the experimental curve that the variation from the predicted forms is noticeable.

In consequence of this peculiarity, the liquid mixture, unless containing a very large proportion of one or other of its constituents, will yield a distillate having a composition approximating closely to that which gives the maximum point. For example, with mixtures of methyl ethyl ketone and water, if the original liquid contains between 10 and 90 per cent. of the ketone, the distillate will contain about 88·6 per cent. of this compound.

109. "The influence of solvents on the rotation of optically active compounds. Part V. The optical activity of certain tartrates in aqueous solution." By Thomas Stewart Patterson.

The rotations of sodium tartrate, potassium tartrate, potassium methyl tartrate, potassium ethyl tartrate, potassium *n*-propyl tartrate, methyl tartrate, ethyl tartrate, and *n*-propyl tartrate have been examined in aqueous solution at several concentrations and at temperatures between 10° and 100°.

In very dilute solution, sodium and potassium tartrates behave alike both as regards rotation value and influence of temperature-change, the rotation increasing as the temperature is raised.

It was shown that the rotations of the homogeneous compounds, could they exist in a superfused condition, would diminish on heating from 0° to 100°.

Of the three potassium alkyl tartrates, the *n*-propyl ester had the highest, and the methyl ester, the least rotation, both in dilute solution and in the homogeneous state. Dilute solutions of these compounds all showed distinct temperatures of maximum rotation.

The rotations of the three alkyl tartrates were all raised by solution in water, and in dilute solution the rotations diminished rapidly on heating, this behaviour being just the opposite of that shown by the homogeneous esters.

The rotations in very dilute solution of the compounds examined were compared with each other and with that of the tartaryl ion.

The relationships existing among the experimental data were discussed with reference to the variations produced by solution and by change of temperature, and some suggestions, based on these observations, were advanced with respect to the temperatures at which the comparisons of rotation values may legitimately be instituted.

110. "The nitration products of the isomeric dichlorobenzenes." By Percival Hartley and Julius Berend Cohen.

The progressive nitration of the dichlorotoluenes has been investigated by Cohen and Dakin (*Trans.*, 1902, **81**, 1344), and the results show that the two nitro-groups in the dinitro-derivatives of the six dichlorotoluenes follow strictly the meta-law of substitution.

Since the publication of the above, three papers describing the nitration products of *o*-, *m*-, and *p*-dichlorobenzenes have appeared (Morgan, *Trans.*, 1902, **81**, 1378; Blanksma and Terwogt, *Rec. trav. chim.*, 1902, **21**, 286; and Blanksma, *ibid.*, 419).

From these it would appear that the principal products of nitration are an ortho-dinitro-compound in the case of *o*-dichlorobenzene, a meta-dinitro-compound in the case of *m*-dichlorobenzene, and a para-dinitro-compound in the case of *p*-dichlorobenzene. The authors have repeated the work in order to ascertain quantitatively how far the divergence from the meta-law holds good.

They have been able to confirm the results of nitration of the *o*- and *m*-dichlorobenzenes, but not of the para-compound. The first gives with great difficulty an ortho-dinitro-compound, the second much more easily a meta-dinitro-compound, but *p*-dichlorobenzene gives about six times as much of the meta-dinitro-compound as of its para-isomeride. The only important exception to the meta-law is therefore afforded by *o*-dichlorobenzene.

At the next meeting on **Wednesday**, June 15th, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"The mechanical analysis of soils and the composition of the fractions resulting therefrom." By A. D. Hall.

"The effect of the long-continued use of sodium nitrate on the constitution of the soil." By A. D. Hall.

"The decomposition of oxalates by heat." By A. Scott.

"Some alkyl derivatives of sulphur, selenium, and tellurium." By A. Scott.

"The ultra-violet absorption spectra of certain enol-keto-tautomerides. Part I. Acetylacetone and ethyl acetoacetate." By E. C. C. Baly and C. H. Desch.

"The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds." By J. N. Collie.

"Our present knowledge of the chemistry of indigo." By W. P. Bloxam.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, June 15th, 1904.

Bellars, Albert Ernest,
Magdalene College, Cambridge.

B.A. Demonstrator of Chemistry, Caius College. Part-author, Ethyl benzylideneanilineacetoacetate (*Trans.*, 1903, vol. 83).

M. M. Pattison Muir.
S. Ruhemann.
R. S. Morrell.
C. T. Heycock.
E. K. Hanson.

Brand, Herbert Frank, M.A.,
13, Clifton Road, Brockley, S.E.

Chief science master, "Westminster City" School. Master of Arts (London). Inter. Science (London), First Class (Chemistry and Physics). Passed B.Sc. (London), 1903, in Chemistry and Physics. Preparing B.Sc. (Honours) in Chemistry.

H. Wilson Hake.
Ernest J. Parry.
J. C. Crocker.
D. B. Butler.
J. B. Coleman.
Edward Bevan.
C. T. Bennett.
C. F. Cross.

Field, W. Eddington, F.I.A. A & M., Vic.,
65, Sutherland Road, Armadale, Melbourne, Victoria, Australia.

Analyst. I was principal Assistant for six years to the late William Johnson, Analyst to the Government of Victoria, and this last 19 years

I have been in practice in Melbourne as an Analytical and Technical Chemist. Reason for joining the Chemical Society—to try and keep in touch with Chemical Science through the Journal of the Society.

A. H. Jackson. Frederic Dunn.
Henry W. Levy. *D. Avery.*
A. W. Craig.

Gerard, Thomas Alfred,
122, Foxhall Road, Nottingham.

Soap Manufacturer. Studied Chemistry under Dr. Clowes, University College, Nottm., during 7 sessions. Managing director and chemist to Gerard Bros., Ltd., The Soap Wks., Nottm.

Frank Clowes. R. M. Caven.
E. T. Shelbourn. *G. D. Lander.*
F. J. R. Carulla.

Gilchrist, James Gray,
48, Ovington Street, Chelsea, S.W.

Science Teacher (Chemistry). Science Student; educated at Aberdeen University and Glasgow Technical College; M.A. of Aberdeen University; Student London Univ.

J. W. Shepherd. Hugh Manners.
G. G. Henderson. *William Briggs.*
Stuart Blofeld.

Hulme, John,
3, Albert Terrace, Stockport.

Journalist. Full course in General Chemistry in the School of Technology, M/c. Special courses in Gas Analysis, Water and Sewage Analysis, Oils and Fats, Chemistry of Essential Oils and Perfumes, and 3 years' extra course in Metallurgy. 1st class success in Cotton Dyeing, Calico and Linen Bleaching, and Calico Printing. Hons. Metallurgy. Desirous of obtaining the full literature published by the Society.

W. J. Pope. J. Allan.
Jas. Grant. F. S. Sinnatt.
S. J. Peachey.

Jenkins, Herbert,
52, Criffel Avenue, Streatham Hill, S.W.

Analytical Chemist. Member of the Chemical, Metallurgical, and Mining Society of South Africa. Desirous of joining the Chemical Society in order to keep pace with the general advancement of Chemical Science. For many years a student of the Birkbeck Institution and The City and Guilds Technical College, Leonard Street, Finsbury, E.C.

R. Meldola. Henry C. Jenkins.
John Castell-Evans. Bennett H. Brough.
F. Southerden. *W. Gowland.*

Johnston, John Haslam,

Public Offices, Hampton, Middlesex.

Chemist and Bacteriologist to the Hampton District Council. M.Sc., University of Manchester. F.I.C.; 3 years in the Chem. Laboratories of Owens College; 2 years in the Public Health and Pharmaceutical Laboratories of Owens College. Joint author with Prof. Delepine "On the effect of sedimentation on running water," *J. State Medicine.*

Harold B. Dixon.	D. L. Chapman.
William A. Bone.	R. S. Hutton.

G. H. Bailey.

Lessing, Rudolf,

31, Brunswick Square, W.C.

Chemist to the Gas Light and Coke Co., Lim., Tar and Liquor Works, Beckton, E. Studied at Munich, Geneva, Berlin. Ph.D., Munich. Worked 5 years under Adolph von Baeyer, and was private assistant to Professor Richard Willstaetter in researches on Diamidoacetic acid and on Quinonediimide. Papers: Ueber Benzolsulfamide (*Ber.*, **33**, 557); Phenyl*cyclo*hexan aus Elsinit (*Ber.*, **34**, 506); Ueber Methylpyrrolidindicarbonsäure (*Ber.*, **35**, 2065). During Summer, 1903, Research Student at Owens College with Professor W. H. Perkin, jun.

H. B. Dixon.	Francis V. Darbishire.
W. H. Perkin, jun.	Norman Smith.
William A. Bone.	Thos. Wilton.
J. F. Thorpe.	Raphael Meldola.

Lowe, Frank Harold,

59a, Fulham Park Gardens.

Lecturer and Demonstrator in Chemical Department, South-Western Polytechnic. Held scholarship and studied 5 years at the Owens College (1892—1897). Graduated B.Sc., Victoria University, with 1st Class Honours in Chemistry, 1896. Late research student at Owens College. One year Demonstrator at the Royal Technical Institute, Salford (1898—1899). Four years Lecturer and Demonstrator at the S. W. Polytechnic (since 1899). Published a paper on "Picryl derivatives of urethane and thiourethane" (*Proc.*, April, 1904) in conjunction with Mr. J. C. Crocker.

J. B. Coleman.	J. Wilson.
J. C. Crocker,	Gerald T. Moody.
A. Harden.	*J. Hart-Smith.*

Oakden, William Edward,

2, Gledhow Terrace, South Kensington, S.W.

Lecturer in Chemistry and Metallurgy at the South-West London Polytechnic (about 6 years). Formerly (about 10 years) Technical Works Manager at Messrs. John Hutchinson and Co.'s Alkali Works, Widnes, and at Messrs. Gaskell, Deacon and Co.'s Works, Widnes, under the United Alkali Company, Ltd. Carried out original investigations and effected considerable improvements and economies in connection with Sulphuric Acid Manufacture and Recovery of Sulphur from Alkali Waste.

J. Bernard Coleman.
J. C. Crocker.
Gerald T. Moody.
G. W. F. Holroyd.
William A. Davis.
Frank Clowes.
R. Grimwood.

Pell, Alfred,

44, Cumballa Hill, Bombay.

General Manager, Kemp and Co., Ltd., Manufacturing Chemists, Bombay, India. General Manager and Head Chemist for the last five years to Messrs. Kemp and Co., Ltd., the largest Manufacturing Chemists in India. Had charge of the Analytical Department for some time. Member of the Pharmaceutical Society. Editor and Compiler of "The Prescriber's Pharmacopœia" for the last four editions (a synopsis of recent remedies, specially written for India, 380 pages). I wish to keep in closer touch with present chemical progress.

John J. Pilley.
D. S. Kemp.
David Hooper.
Gerald Martin.
A. Milne.

Pinkerton, David John,

17, Orbiston Street, Motherwell.

Analytical Chemist. Three years a Student and one year Private Assistant with (the late firm of) Messrs. Wallace, Tatlock, and Clark, City Analysts, Glasgow; four years Chemist and Assistant Manager Paisley Corporation Gas Works; two years Chemist Glasgow Corporation Gas Works; at present Chief Chemist at Dalzell Steel and Iron Works (Messrs. D. Colville and Sons, Ltd.), Motherwell.

John Clark.
R. R. Tatlock.
R. T. Thomson.
A. Humboldt Sexton.
G. G. Henderson.

Rodger, Robert,

54, Rostrevor Road, S.W.

Analytical Chemist. Student, Royal College of Science, 1896–98. Since then Analyst in the Government Laboratory.

T. E. Thorpe.
G. T. Morgan.
William A. Tilden.
M. O. Forster.
C. Proctor.

Sanders, Percy Richard,

West Cliffe, Seaford, Sussex.

Chemical Officer under Inland Revenue Department. Student at Royal College of Science, London, 1896–7, 1897–8. Assistant Analyst at Government Laboratory, 1898—1900. Chemical Officer under Inland Revenue Department, 1900 to date.

T. E. Thorpe.
H. W. Davis.
Geo. Stubbs.
J. Holmes.
G. E. Tomlins.

Sawer, Charles John,

6, Cleveland Road, Brighton.

Student. Investigator of aromatic products. F.L.S. (elected 1881). Author of "Odorographia," 1892–94; "Rhodologia." Contributor to various technical publications and journals; such as the *Encyclopædia Britannica, Le Moniteur Scientifique, Descriptive Catalogues of Museums, The Pharmaceutical Journal, Chemist and Druggist, British and Colonial Druggist, Journal of the Imperial Institute, Knowledge, Journal of Applied Science, The Produce World, Bulletin of the Department of Agriculture, Jamaica, The West Indian Bulletin, Barbados.*

Peter MacEwan.
W. H. Gibson.
Ernest J. Parry.
Benj. H. Paul.
Herbert E. Burgess.
M. C. Clutterbuck.
William Jago.

Shelton, Henry Stanley,

4, Larden Road, Acton Vale, W.

Teacher of Chemistry. Assistant in the Chemical Department, Northern Polytechnic Institute. Previously Science Master at the Grammar School, Thame, Oxford, and the Grammar School, Southwell, Notts. For 2 years (1901—1903) Ordinary and Research Student at University College, London.

William Ramsay.
W. H. Mills.
F. G. Donnan.
Samuel Smiles.
Morris W. Travers.
Alex. W. Bain.

Weinberg, John,

Rosa United Provinces, India.

Chemist to Rosa Sugar Works and Distillery. Formerly Chemical Assistant: Experimental Station for Sugar Cane, Pasoeroean. Assistant: Station for Cane diseases, Probolinggo. Head Chemist: Pakkie's Sugar Mills. Published: Java Sugar *Archief*; Determination of Quotient of Purity of Cane juices; Sample taking of Sugar. And Agricultural Ledger, India; Deterioration of Cut Sugar Cane; Secondary constituents of Indian Country Spirits.

William Tate. W. T. Grice.
David Hooper. Paul Brühl.
P. C. Rây.

Wilkinson, James Alfred,

Johannesburg.

Late Senior Science Master, Johannesburg College, Barnato Park, Johannesburg. Now Assistant Professor of Chemistry, Transvaal Technical Institute. First Class Natural Sciences Tripos, late Langworthy, Shakspere, and Seaton Scholar, Manchester Grammar School; Scholar of Gonville and Caius College, Cambridge. B.A., 1896, M.A., 1899. Seven years' experience in Science Lecturing and Teaching in Cambridge and Johannesburg.

M. M. Pattison Muir. R. S. Morrell.
S. Ruhemann. T. B. Wood.
J. Murray Crofts.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY SUFFOLK.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 283.

Wednesday, June 15th, 1904. Prof. W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. G. Dean, C. D. McCourt, J. C. Smith, R. de J. Fleming-Struthers, and C. H. Thompson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William H. R. Allen, c/o Straits Trading Co., Butterworth, Penang, S.S.
Jabez Horace Cooper, 13, Victoria Terrace, Exeter.
George Frederick Phillips, B.Sc., Colworth Road, Leytonstone.
Edwin Roy Watson, B.A., B.Sc., 1, Fair Street, Cambridge.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Albert Ernest Bellars, B.A.
Herbert Frank Brand, M.A.
W. Eddington Field.
Thomas Alfred Gerard.
James Gray Gilchrist, M.A.
John Hulme.
Herbert Jenkins.
John Haslam Johnston, M.Sc.
Rudolf Lessing, Ph.D.
Frank Harold Lowe, B.Sc.
William Edward Oakden.
Alfred Pell.
David John Pinkerton.
Robert Rodger.
Percy Richard Sanders.
Charles John Sawer.
Henry Stanley Shelton.
John Weinberg.
James Alfred Wilkinson, M.A

The PRESIDENT stated that six of the seven Past Presidents to whom the Society desired to do special honour at the Banquet held in 1898 having passed away, the Council felt that there should be no further delay in the publication of a memorial notice of the life and work of each. Arrangements had accordingly been made for the preparation of such notices, which, it was hoped, would be incorporated in the volume of Transactions for the present year. The list includes the name of Frankland, concerning whom a Memorial Lecture had been delivered by Professor Armstrong at a special meeting of the Society in October 1901. Repeated application for the manuscript having been unsuccessful, and nearly five years having elapsed since the death of Sir Edward Frankland, the Council were arranging for the preparation of an independent obituary notice.

The PRESIDENT further stated, for the information of the Society, that arrangements had been completed for the publication annually of Reports on the Progress of Chemistry under the several heads employed in the Journal for the classification of the Abstracts, with addition of a new section on "Radio-activity." It was expected that these reports, collected into an extra number of the Journal, would be ready for issue to the Fellows early in the spring of each year.

The attention of the Fellows was also requested to the notice inside the cover of the Journal relating to the International Tables of Atomic Weights, which are now printed on cards to be obtained from the Society's Agents, Messrs. Gurney and Jackson.

Of the following papers, those marked * were read:

*111. "The mechanical analysis of soils and the composition of the fractions resulting therefrom." By Alfred Daniel Hall.

The object of the investigation was to ascertain the effect of introducing into the mechanical analysis of soils a preliminary treatment of the soil in dilute acid followed by ammonia as first suggested by Schlœsing. For the separation into fractions, the beaker method of sedimentation as worked out by Osborne was adopted, the soil being divided into two fractions by sieves and five by sedimentation from water. Eighteen soils of known history were selected from the Rothamsted experimental plots, to give comparisons of the same soil in an unmanured condition and when rich in humus through the accumulation of organic matter.

The proportions in which the groups of particles of given sizes occur in a soil are presumably constant for the particular type of soil;

the actual state of aggregation of the particles at any given time or place determines what may be termed the texture of the soil and depends on a number of temporary factors, such as the cultivation to which the soil has been subjected, the amount of humus present, the use of lime or of saline manures, &c. It is held that no method of mechanical analysis can measure the existing texture of the soil, although that texture does ultimately depend on the size of the particles composing the soil. If, however, the method of mechanical analysis can be made to show the ultimate physical constitution of the soil, a measure is obtained of the capacity of the soil to acquire a known texture under given methods of cultivation.

On comparing the results obtained by sedimenting the Rothamsted soils with and without the preliminary treatment in dilute acid, it is found that the raw soil rarely yielded as much of the finest or "klay" fraction as did the same soil after washing with acid, and that the difference was greatest when pastures and other soils rich in humus were examined, but practically disappeared with soils which had been deprived of their humus and deflocculated by long treatment with saline manures. As no valid reasons exist for supposing that the acid treatment can break down large particles into smaller ones, it is concluded that in carrying out a mechanical analysis on the raw soil many aggregates of the finest particles are left unresolved, but fall apart when the humates, which act as a weak binding material, are removed by the treatment with dilute acid followed by ammonia. A further action of the acid treatment is to remove all traces of soluble salts, which would otherwise cause flocculation and interfere with the sedimentation. It is only when dealing with soils containing a fair amount of humus that there will be much difference between the results obtained by the two methods, but, inasmuch as only the acid treatment yields an exact sorting out of the ultimate inorganic particles of the soil, whereas working on the raw soil leaves some of the finest particles still unseparated, the general conclusion is reached that the acid treatment should be adopted in all cases.

With the Rothamsted soils, the method involving a preliminary treatment with acid shows the essential identity of soils from the same experimental field whatever the manuring has been, whereas the analyses made on the raw soil give very different results, depending on the treatment the various plots have received.

Determinations made of the alumina, silica, and ferric oxide in the various fractions separated by mechanical analysis show that although the proportion of alumina increases as the particles composing the fraction become smaller, these fractions do not possess any chemical individuality, but are determined by the size and not by the chemical composition of the particles.

*112. "The effect of the long-continued use of sodium nitrate on the constitution of the soil." By Alfred Daniel Hall.

On reviewing the results of the mechanical analysis of Rothamsted soils, it was observed that those which had been manured with sodium nitrate every year gave abnormal results; a further series of fifteen soils was examined drawn from each of the Rothamsted fields where plots with and without sodium nitrate occurred. In general, the use of sodium nitrate has resulted in a lower proportion of "klay" being left in the surface soil. This result was most manifest in the mangel field, where cultivation is frequent, and was not apparent at all in the grass field, where the turf protects the soil from the washing action of the rain.

The removal of the finest particles from the surface soil is attributed to deflocculation induced by the use of sodium nitrate and followed by the washing of the finest particles into the subsoil. This hypothesis is confirmed by chemical analysis of the "klays" separated in the mechanical analysis, by mechanical analysis of some of the subsoils, which were found to be richer in fine particles beneath the soils receiving nitrate, and by the condition of the same soils in the field, which showed every evidence of deflocculation.

Discussion.

Dr. Voelcker said that although he could not go so far as Mr. Hall in his estimation of the value of mechanical as against chemical analysis of soil, he nevertheless recognised the importance of the former and the advance which had been made with regard to it. It seemed, however, remarkable in the first paper that such similarity of composition was shown in the different separations formed by washing the soils.

In regard to the second paper he could, from his own experiments on the Woburn soil—a light sandy one and very different to that at Rothamsted—quite bear out what had been noticed with respect to the action of sodium nitrate. On washing the former soil continuously with solutions of this salt, the finer portions of soil were carried down and the subsoil after a time became quite different in texture, forming a consolidated mass through which the water would not percolate. This was due, no doubt, as the author had indicated, to the carrying down of the finer particles. In this respect, great differences were noted between the action of sodium nitrate and that of the sulphate and other salts of ammonium.

Dr. E. J. Russell pointed out that what was really wanted was a knowledge of the total surface of the soil particles to a depth of say six inches; mechanical analysis gave very useful results but was not entirely satisfactory. There are some fundamental objections to the method; small particles from near the bottom of the column of liquid are deposited along with the larger particles which take the same time to travel from the top, and the deposit is therefore a mixture. Moreover, a disc-shaped particle will tend to place itself broadside on and be deposited simultaneously with a spherical particle of about the same sectional area. Consequently, it cannot be assumed that the particles have even approximately the same surface, although under the microscope the sediment may appear to be fairly homogeneous.

Mr. F. J. Lloyd said that the study of the physical nature of the soil had been neglected in England, whereas the remarkable researches of Whitney in America had shown that valuable information could be derived from this investigation. He regretted that the author had stated that the physical study yielded more important results than the chemical examination, because in his opinion the nature of the soil could only be discovered by the investigation of both its physical and chemical properties.

Mr. T. S. Dymond pointed out that the method employed by the author involved the complete disintegration of the soil aggregates produced by years of cultivation. What information of value bearing on the proper treatment of cultivated land could be obtained if the previous history of the soil were obliterated previous to analysis? More practical knowledge could be gained by the rough examination of the soil of a field with a spade than by the old methods of mechanical analysis. Would not this be still more true of the method now proposed?

Dr. Luxmore said that as the aim of mechanical analysis was to determine the structure of the soil it was needful in the first place to know the total quantity of the finest materials, which sometimes formed a layer over the coarser particles. If in addition to this a method could be derived by which the state of tilth could also be determined this would be a further advantage. One great benefit of the preliminary treatment with acid lay in the saving of time which it involved in a long and tedious process. From his own observations on the soils of Dorset he knew that the dissolved material other than calcium carbonate was very small in amount.

Mr. Hall, in reply, said that he would not attempt to consider the question raised by Dr. Voelcker and Mr. Lloyd as to the value of the mechanical analysis of a soil; the method, however, aimed at gauging the behaviour of a soil towards water, and the size of crops even in this humid climate was determined more by the amount of water available than by the soil constituents usually regarded as plant food. He agreed with Dr. Russell that the working surface of the soil particles was probably the factor of most importance, and one which could only be imperfectly deduced from the mechanical analysis. He did not, however, anticipate that it would be possible to estimate directly the behaviour of a soil in the field from any of the measurements they could obtain; the function of the mechanical analysis was rather to enable one to relegate a given soil to one or other of certain known types, the working qualities of which had been already ascertained by experience. This meant, then, the accumulation of the necessary data for a number of soils, and the first essential was to obtain a method which was so far accurate that it represented the permanent and not the accidental or temporary features of the soil.

*113. "The decomposition of oxalates by heat." By Alexander Scott.

In spite of the simple formulæ given to the oxalates, their decomposition by heat is by no means as simple as usually stated. Ordinary precipitated calcium oxalate turns grey on ignition, and this change, which is due to the separation of small quantities of carbon, occurs even with the purest calcium oxalate. This salt gives very little carbon dioxide and carbon, but always a little of each, decomposing practically in accordance with the equation usually given, $CaC_2O_4 = CaCO_3 + CO$.

Sodium and barium oxalates decompose in accordance with the following equations:

$$7Na_2C_2O_4 = 7Na_2CO_3 + 3CO + 2CO_2 + 2C,$$
$$8BaC_2O_4 = 8BaCO_3 + 6CO + CO_2 + C.$$

Magnesium oxalate gives exactly equal volumes of carbon dioxide and monoxide and no carbon, $MgC_2O_4 = MgO + CO + CO_2$, but almost all the other oxalates tested gave notable quantities of carbon dioxide and carbon.

*114. "Some alkyl derivatives of sulphur, selenium, and tellurium." By Alexander Scott.

When sulphur is heated at 180° with methyl iodide, 1 atom unites directly with 3 molecules of the iodide, forming the di-iodide of trimethylsulphine iodide, which is obtained as an almost black oil, but after this has been freed from excess of methyl iodide the solid, $S(CH_3)_3I,I_2$, may be obtained by dissolving the oil in ethyl acetate and precipitating by means of ether, when it separates in dark purple scales melting at 38°. Selenium behaves in an exactly similar way, the $Se(CH_3)_3I,I_2$ melting at 39°. To reduce these to trimethyl-sulphine and -selenetine iodides, water is added to their solutions in ethyl acetate and hydrogen sulphide is passed in until the liquid is colourless.

As Demarçay has shown, the action of methyl iodide on tellurium at 80° gives rise to tellurium dimethyl di-iodide, $Te(CH_3)_2I_2$, but this is not decomposed by heating to 180°, nor does it give a compound corresponding with those obtained from sulphur and selenium. To obtain tellurium trimethyl iodide, the di-iodide is dissolved in methyl iodide and equivalent quantities of sodium sulphite and sodium carbonate are added. The reaction takes place thus:

$$Te(CH_3)_2I_2 + CH_3I + Na_2SO_3 + H_2O = Te(CH_3)_3I + Na_2SO_4 + 2HI,$$

the hydrogen iodide being then neutralised by the sodium carbonate. The tellurium trimethyl iodide is readily separated from the sodium salts by crystallisation.

The di-iodide of tellurium trimethyl iodide, produced by adding iodine to the iodide, is readily obtained in fine purple scales (m. p. 76·5°) by precipitation of its solution in ethyl acetate by means of ether.

Allyl iodide readily dissolves tellurium in the cold, giving an orange-coloured oil, from which the element is very readily obtained again. Ethyl iodide reacts in the same way as methyl iodide.

The author showed several reactions of tellurium dimethyl di-iodide and its derivatives.

*115. "The ultraviolet absorption spectra of certain enol-keto-tautomerides. Part I. Acetylacetone and ethyl acetoacetate." By Edward Charles Cyril Baly and Cecil Henry Desch.

An attempt was made to determine the constitution of the metallic derivatives of acetylacetone and ethyl acetoacetate by means of their ultraviolet absorption spectra. The absorption spectra of alcoholic solutions of the aluminium, beryllium, and thorium derivatives of acetylacetone and the aluminium compound of ethyl acetoacetate were photographed, as well as those of the parent substances. Hartley and Huntington's method of experiment was adopted, but a different method of drawing the curves of absorption was employed. From a consideration of the absorption curves of acetylacetone and its metallic derivatives, it is evident that the constitution of these substances is very similar, as they all show a strong absorption band, the limits of which are very much the same in every case.

Ethyl acetoacetate, on the other hand, shows no absorption band, whilst its aluminium derivative shows a strong band almost identical with those of the acetylacetone group.

These results appeared at first to indicate that acetylacetone and its derivatives and the aluminium compound of ethyl acetoacetate had the enolic formula, and suggested the keto-formula for ethyl acetoacetate itself. This view was not upheld by the study of the spectra of ethyl ethylacetoacetate, and its isomeride, ethyl β-ethoxycrotonate; in both cases, only continuous absorption was obtained without any band at all. The band therefore cannot be characteristic of either the enolic or the keto-modification, but appears to be due entirely to the dynamic isomerism between the two forms. Experiments were made to test this by observing the action of sodium hydroxide or hydrochloric acid, which should materially alter either the size or the persistence of the absorption band; the former reagent should increase it, and the latter decrease it owing to their accelerating and retarding influence respectively on the dynamic isomerism. It was found that a very small amount ($\frac{1}{2}$ equivalent) of sodium hydroxide produced a band in the absorption spectrum of ethyl acetoacetate, this band being increased by the addition of more alkali until with excess it was larger and more persistent than that given by the aluminium derivative. Hydrochloric acid was found to have a marked action in decreasing the absorption of ethyl acetoacetate; its action was better observed in the case of ethyl β-aminocrotonate, when it was found that the absorption band was decreased more and more by repeated addition of small quantities of the acid.

The conclusion is therefore drawn that with acetylacetone, ethyl acetoacetate, and their metallic derivatives, a state of dynamic isomerism exists in the solution; that the presence of the band in their absorption spectra is due to this isomerism, and that its persistence is a measure of the number of molecules in the state of vibration. It would thus appear that the absorption band is a method of measuring the amount of reaction taking place between two isomeric substances which are in equilibrium.

*116. "The action of acetyl chloride on the sodium salt of diacetylacetone and the constitution of pyrone compounds." By John Norman Collie.

The action of acetyl chloride on the sodium salt of diacetylacetone was investigated with the object of determining whether the introduction of two acetyl groups into dimethylpyrone would destroy its property of forming salts with acids.

As a result of the action of acetyl chloride dissolved in chloroform on the sodium salt, a compound melting at 124° was obtained, which was undoubtedly diacetyldimethylpyrone (compare Thomas and Lefèvre, *Bull. Soc. chim.*, 1888, 50, 193—194). On repeating this operation, the chief substance produced melted at 954°, whilst in another experiment, in which the substances were allowed to react at the temperature of a freezing mixture, a compound melting at 75° was obtained.

These three substances were isomeric, having the formula $C_{11}H_{12}O_4$, and were produced according to the equations:

$$C_7H_8O_2 + 2NaOH = C_7H_8O_3Na_2 + H_2O.$$
$$C_7H_8O_3Na_2 + 2C_2H_3OCl = C_7H_6O_2(C_2H_3O)_2 + 2NaCl + H_2O.$$

(1) Diacetyldimethylpyrone gave no coloration with ferric chloride, and could be sublimed; when boiled with barium hydroxide solution, a yellow barium salt was produced, which dissolved in dilute hydrochloric acid and gave a deep red coloration with ferric salts. Bromine was not decolorised by it. The original substance was totally devoid of any basic properties, and gave neither a hydrochloride nor a platinichloride.

(2) The compound melting at 95° gave a purple coloration with ferric chloride solution, and the orcinol reaction with chloroform and caustic soda. When heated with 80 per cent. sulphuric acid, acetic acid and orcinol were obtained; it gave, with bromine, a monobromoderivative, ($C_{11}H_{11}O_4Br$) (m. p. 79°), and, with acetic anhydride, a monoacetyl derivative, $C_{11}H_{11}(C_2H_3O)O_4$ (m. p. 75°). It dissolves in aqueous soda with a yellow colour, and, after boiling, can be reprecipitated unchanged on the addition of an acid; it is, therefore, diacetylorcinol.

(3) The third substance (m. p. 75°) also gave a purple-red coloration with ferric chloride; it decolorised a solution of bromine in the cold, and, after heating for some time, gave the orcinol reaction with caustic soda and chloroform, but, on warming with this alkali, it also was transformed into the compound melting at 94°, whilst with hydrochloric acid it changed into diacetyldimethylpyrone (m. p. 124°). These curious transformations receive scanty explanation from the accepted molecular constitution of dimethylpyrone, and formulæ for pyrone and its derivatives were brought forward with the view of explaining the foregoing transformation.

*117. "Our present knowledge of the chemistry of indigo." By William Popplewell Bloxam.

As the determination of the maximum amount of indigo obtainable at each successive stage of its preparation ("mahai") and of the quantity present in the leaf of the green plant depends on the purity of the indigotin employed as a standard, the author has estimated the percentage of nitrogen in the best specimens procurable, and has thus found that they contain only about 90 per cent. of indigotin.

Since the pure substances could not be prepared by the action of solvents on cake indigo or the synthetical product, the crude indigo was sublimed under diminished pressure, and in this way a well crystallised product was readily obtained which gave the percentage of nitrogen required for indigotin.

This pure material when sulphonated and subjected to analysis by the permanganate method was found to give values ranging up to 300 per cent. of the weight of substance taken. As this method is used in ordinary technical analyses of indigo, this result explained the extraordinary variations observed in the published values given for cake indigo and the products obtained during the successive stages of the manufacture (" mahai ").

It has also been found that the red substance occurring in the cake obtained from plant-indigo and known as "indirubin" or indigo-red, is not, as stated, a derivative of indigo, as it contains no nitrogen. This material, which may consist of a mixture of compounds, will be further investigated.

118. "$\Delta^{1:3}$-Dihydrobenzene." By Arthur William Crossley.

Dibromotetrahydrobenzene, prepared by Baeyer's method (*Annalen*, 1894, **278**, 88), is a colourless, highly refractive liquid, boiling at 116—117°/29 mm. When treated with concentrated alcoholic potassium hydroxide, it yields a small quantity of $\Delta^{1:3}$-dihydrobenzene, but principally the *ethyl ether*, $C_6H_9 \cdot O \cdot C_2H_5$, of *hydroxytetrahydrobenzene* as a colourless liquid boiling at 155°, and possessing a pungent odour of peppermint.

Quinoline removes two molecules of hydrogen bromide from dibromotetrahydrobenzene, giving $\Delta^{1:3}$-dihydrobenzene, which boils at 81·5—82°/767 mm., and, like the dihydrobenzene obtained from dihydroresorcin (Crossley and Haas, *Trans.*, 1903, **83**, 494), is characterised by only adding on two atoms of bromine to form 1 : 4-dibromo-Δ^2-tetrahydrobenzene melting at 104·5°, and decomposing with evolution of hydrogen bromide at 170°. That this substance is in reality a dibromotetrahydrobenzene is proved by the fact that on treatment with quinoline it loses two molecules of hydrogen bromide with formation of benzene.

119. "The absorption spectrum of *p*-nitrosodimethylaniline." By Walter Noel Hartley.

It was pointed out that the usual formula assigned to benzoquinone is less consistent with its chemical properties as an oxidiser than the peroxide formula and that an unreduced benzene ring is in accord with the optical properties of the substance, since its spectrum exhibits powerful absorption bands. The usual formula, on the other hand, contains the partially reduced carbon ring present in hydroaromatic substances, and the spectra of these are characterised by an absence of absorption bands. The absorption bands in the ultra-violet are always associated with the production of colours, even when the substance examined shows no visible colour, and such substances are in reality chromogens (*Trans.*, 1887, 51, 154—202). Nitroso-compounds of the aromatic series have a powerful and extensive selective absorption in the ultra-violet, and it was thought possible to draw a distinction between these and the closely related oximes.

The following conclusions were deduced : 1. The absorption caused by *p*-nitrosodimethylaniline at the less refrangible end extends into the infra-red, and at the more refrangible far into the ultra-violet. The transmitted rays are thus restricted to a band of yellow and green light bordered on either side by a band of intense absorption.

2. There appears to be a decided difference in constitution as judged by their spectra between *p*-nitrosophenol or quinoneoxime and *p*-nitrosodimethylaniline which cannot be accounted for by a substitution of hydroxyl for the group $N(CH_3)_2$.

3. The alkyl substituted phenols and anilines absorb varying quantities of the ultra-violet, the absorption not extending into the visible spectrum, but the introduction of the NO, as distinguished from the NOH group, extends the absorption far into the coloured rays. This appears to be a characteristic effect of the nitrosyl group in conjunction with the benzene ring.

4. Although the absorption of rays in the blue and violet by *p*-nitrosodimethylaniline is strong, there is at a certain dilution a transmission of the greater part of the ultra-violet.

This explains the action of Wood's screen, which cuts off the visible rays while it transmits some of the ultra-violet. On testing the solutions of *p*-nitrosodimethylaniline, it was found that some red rays were still transmitted, but it is quite possible to adjust the thickness of the solutions so that with a quartz lens and electric light what appears to be perfect darkness causes the fluorescence of uranium nitrate and barium platinocyanide. The appearance of the crystals was brightest when some obscure or feeble blue rays were transmitted.

From a consideration of the facts referred to in connection with conclusion 3, and the previous observations on benzoquinone and its oxime, dioxime, chloroimide, and dichloroimide, it appears to be not improbable that a solution of *p*-nitrosophenol is a mixture of two tautomeric forms, the one a phenol and the other an oxime.

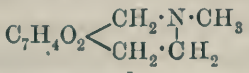
120. "The influence of solvents on the rotation of optically active compounds. Part VI. The relationship between solution-volume and rotation of the dialkyl and potassium alkyl tartrates in aqueous solution." By Thomas Stewart Patterson.

Values for the molecular solution-volumes of dimethyl-, diethyl-, di-*n*-propyl, potassium methyl-, potassium ethyl-, and potassium *n*-propyl-tartrates are given, and the changes of volume due to solution in water compared with the corresponding changes in rotation. It is shown that in both series a contraction of 1 c.c. per gram-molecule produces the greatest change of rotation in the methyl and the least change of rotation in the *n*-propyl ester, and that the perplexing rotation changes of these compounds, due to solution in water, can at least be brought into harmony when a causal connection between solution-volume and rotation is assumed.

121. "The constitution of hydrastinine." James Johnston Dobbie and Charles Kenneth Tinkler.

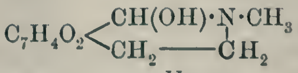
The study of the absorption spectra of hydrastinine, $C_{11}H_{13}O_3N$, has yielded results precisely similar to those obtained with cotarnine (*Trans.*, 1903, 83, 598).

Solutions of hydrastinine in ether or chloroform are, like the solid substance, colourless, and their absorption spectra are practically identical with the spectra of hydrohydrastinine, a compound which is generally considered to have the constitution represented by formula I. From this, it is argued that the carbinol formula II, which represents hydrastinine as differing from hydrohydrastinine only in the replacement of an atom of hydrogen by a hydroxyl group, should be preferred to the open-chain or aldehydic formula of Roser, which would leave the agreement between the absorption spectra of the two substances entirely unexplained.



$$C_7H_4O_2<\begin{matrix}CH_2\cdot N\cdot CH_3\\ \quad\quad\quad | \\ CH_2\cdot CH_2\end{matrix}$$

I.
Hydrohydrastinine.



$$C_7H_4O_2<\begin{matrix}CH(OH)\cdot N\cdot CH_3\\ \quad\quad\quad\quad\quad | \\ CH_2 \text{——} CH_2\end{matrix}$$

II.
Hydrastinine
(carbinol form).

On the other hand, the aqueous or alcoholic solutions of hydrastinine, which are yellow and fluorescent, give spectra which agree with those of the hydrastinine salts. It would therefore appear that, under the influence of these solvents, hydrastinine changes from the carbinol to the ammonium base, the hydroxyl group shifting from the carbon atom to the nitrogen and forming the complex $>N(CH_3)\cdot OH$.

The spectra of the colourless solutions agree closely with those of the corresponding solutions of cotarnine. The spectra of the coloured solutions possess three absorption bands corresponding in position with two bands in the cotarnine spectra.

All the hydrastinine derivatives examined give spectra which are identical or nearly so with those of hydrohydrastinine or of the hydrastinine salts.

Alcohol imparts a yellow colour to an ethereal solution of hydrastinine, the depth of colour increasing as the proportion of alcohol to ether is increased. An examination of the spectra of such solutions shows that as alcohol is gradually added the carbinol form changes into the ammonium base form. The opposite change is brought about by the addition of alkalis to the yellow solution of hydrastinine compounds, the disappearance of the fluorescence marking the complete conversion of the ammonium base form into the carbinol form.

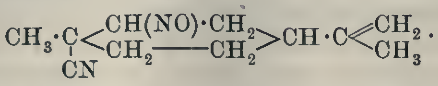
122. "The influence of moist alcohol and ethyl chloride on the boiling point of chloroform." By John Wade and Horace Finnemore.

Chloroform, when made from alcohol, contains a small quantity of ethyl chloride, the absence of which from chloroform made from acetone detracts from its efficiency as an anæsthetic. The ethyl chloride depresses the boiling point of the chloroform; it was partially isolated by fractionation through a Young's evaporator column, and was identified by conversion into silver propionate.

Incidentally, the authors have isolated binary mixtures of chloroform and alcohol, and chloroform and water, and a ternary mixture of chloroform, alcohol, and water, all of minimum boiling point. The first binary mixture boils at 59·4°/760 mm., has a sp. gr. 1·4125 at 15°/15°, and contains 7 per cent. of alcohol. The second binary mixture boils at 56·1°/760 mm., and contains about 1 per cent. of water. The ternary mixture boils at 55·5°/760 mm., and contains 4 per cent. of alcohol and about 3·5 per cent. of water. The water in both these mixtures separates at once from the distillate.

123. "Limonene nitrosocyanides." By William Augustus Tilden and Frederick Peacock Leach.

The nitrosocyanide referred to (*Proc.*, 1902, 18, 163) by Tilden and Burrows as a liquid is found to be a crystalline, optically active solid, m. p. 90—91°, and $[\alpha]_D$ +165°; it yields a benzoyl derivative, which crystallises in shining plates melting at 107°. The nitrosocyanide has a monomolecular structure, $C_{10}H_{16}NO\cdot CN$, and, the formula for limonene having been recently established by Perkin, the nitrosocyanide must be represented as follows:



$$CH_3\cdot\underset{\mid \atop CN}{C}<\begin{matrix}CH(NO)\cdot CH_2\\ CH_2\text{——}CH_2\end{matrix}>CH\cdot C<\begin{matrix}CH_2\\ CH_3\end{matrix}.$$

This compound is obtained by digesting limonene β-nitrosochloride with potassium cyanide. It is also the chief product of the same treatment of the mixed α- and β-nitrosochlorides. It has not yet been obtained from pure α-nitrosochloride, which yields a viscid product, but from the latter a benzoyl compound is obtained, which is identical with the benzoyl derivative of the β-nitrosocyanide. The investigation will be continued.

124. "Photochemically active chlorine. II. A preliminary notice."

By Charles Hutchins Burgess and David Leonard Chapman.

A considerable number of experiments have now been performed with the purpose of discovering the conditions under which the activity of chlorine gas or its solution is induced and destroyed (this vol., p. 52), the following being a brief summary of some of the results obtained:

(1) Active chlorine is formed by the action of light or heat on inactive chlorine. (2) Moist chlorine, when heated to the boiling point of water and then cooled to the ordinary temperature, is rendered almost as active as by the action of light. (3) By the passage of the electric discharge through inactive chlorine (compare J. W. Mellor, this vol., p. 140).

It has also been shown that freshly prepared electrolytic gas and chlorine are almost at their maximum activity, and in measuring the activity of either of these gases it is very necessary to make sure that the chlorine contained in the control actinometer is inactive.

It has now been observed that aqueous solutions of certain acids and salts are more effective in removing the activity than pure water.

An active solution of chlorine in water can be prepared either by leaving the liquid in contact with active chlorine or by heating aqueous solutions of chlorine.

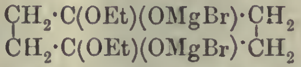
Only a very small fraction of the activity is removed by pumping the chlorine out of an active solution under diminished pressure, and when an active solution is distilled in a vacuum both the distillate and the residual liquid are active. Aqueous solutions of chlorides through which ozone has been passed are more active than solutions of the same strength which have not been thus treated.

The residual liquid remaining after removing the chlorine under diminished pressure, when treated successively with potassium iodide and *N*/10 thiosulphate, still retains a large proportion of its activity.

The condition of the moist chlorine having been found to be the cause of the induction period, experiments were made for the purpose of deciding whether this phenomenon is due to the formation of a compound of the type Cl_2,H_2O, which is subsequently destroyed by hydrogen with the formation of hydrochloric acid. Comparative measurements of the induction period and of the rate of formation of hydrochloric acid after the induction period were made, and on applying the law of mass action to the results it was seen that if the foregoing assumption is correct then at least one-half of the chlorine in the actinometer must have been converted into the compound Cl_2,H_2O before hydrochloric acid began to be formed in appreciable quantity, a result which is obviously absurd.

The conditions of formation of active chlorine precisely correspond with those which are known to be necessary for the substitution of hydrogen in the side chain of a benzene compound.

125. "Additive compounds of anhydrous magnesium bromide with organic oxygen and nitrogen compounds." By John Joseph Sudborough, Harold Hibbert, and Stanley H. Beard.

In attempting to prepare  $\begin{array}{l} CH_2\cdot C(OEt)(OMgBr)\cdot CH_2 \\ CH_2\cdot C(OEt)(OMgBr)\cdot CH_2 \end{array}$ by the action of a dry ethereal solution of ethylene dibromide on ethyl succinate in the presence of dry magnesium, an additive compound of magnesium bromide and ethyl succinate was obtained. This is an extremely hygroscopic, crystalline solid which may readily be prepared by the direct union of its components; it has the composition $(CH_2\cdot CO_2Et)_2,MgBr_2$.

Additive products of other organic oxygen compounds, such as ether, amyl ether, benzaldehyde, cinnamaldehyde, benzophenone, pyruvic acid, and ethyl benzoate, have been obtained. Amines and nitrites appear to be capable of forming similar additive compounds, whereas hydrocarbons are not.

The compounds are all extremely hygroscopic and difficult to obtain quite pure.

126. "Differentiation of primary, secondary, and tertiary amines. A preliminary note." By John Joseph Sudborough and Harold Hibbert.

L. Meunier (*Compt. rend.*, 1903, 136, 758) has shown that primary and secondary amines react with magnesium methyl iodide in ethereal solution according to the equations $RNH_2 + CH_3{\cdot}MgI = RNH{\cdot}MgI + CH_4$ and $RR'NH + CH_3{\cdot}MgI = RR'N{\cdot}MgI + CH_4$.

It is now shown that with primary amines and a solution of magnesium methyl iodide, in amyl ether the reaction proceeds quantitatively in the cold, as stated by Meunier, but that when the solution is heated a second molecule of methane is set free, presumably according to the equation $RNH{\cdot}MgI + CH_3{\cdot}MgI = RN(MgI)_2 + CH_4$.

When a secondary amine is used, only one molecule of methane is evolved for each gram-molecule of the compound, even on heating.

Tertiary amines do not evolve any gas when mixed with Grignard's reagent.

The compounds examined so far have been *p*-toluidine, β-naphthylamine, diphenylamine, carbazole, and dimethylaniline. It is the intention of the authors to extend the work, and on these reactions to base methods for the characterisation of amino- and imino-groups and for the estimation of the amounts of primary, secondary, and tertiary amine in a mixture.

127. "Influence of radium radiations on labile stereoisomerides." By John Joseph Sudborough.

The relative effects of exposing labile stereoisomerides to sunlight and to radium radiations have been examined. The substances used were *allo*-cinnamic, α-bromo-*allo*-cinnamic, and β-bromo-*allo*-cinnamic acids.

It has been already shown (Trans., 1903, **83**, 685, 1166) that these acids are transformed to a large extent into the more stable isomerides by the action of light or heat.

Prolonged exposure in the dark to the rays from pure radium bromide (1 mg.) does not affect the melting points of the acids.

The three acids, melting respectively at 68°, 120—121°, and 159—160°, were exposed to the radiations during a period of four months: at the end of this time no change in appearance and practically no alteration in melting point could be detected; the melting points found were 68°, 118—121°, and 158—160°. Specimens of the same acids were exposed to sunlight on March 17th, and by April 7th the melting points were considerably affected. The *allo*-cinnamic acid then began to melt at 60°, the α-bromo-*allo*-acid at 100°, and the β-bromo-*allo*-acid at 145°. On June 13th, the *allo*-cinnamic acid began to melt at 60° and was nearly completely fused by 120°, although a small amount of solid still remained at 145°. The α-bromo-*allo*-acid began to melt at 90° and was completely fused at 105°; the β-*allo*-acid began to melt at 120° and was completely fused at 135°, thus indicating that the three *allo*-acids are transformed into the stable isomerides more readily under the influence of light than by prolonged exposure to radium radiations.

128. "Notes on analytical chemistry." By Gilbert Thomas Morgan.

I. *The Separation of Arsenic by Distillation in Hydrogen Chloride.*—A modification of Piloty and Stock's apparatus (*Ber.*, 1897, **30**, 1649) was described in which the mixed sulphides of arsenic and antimony were distilled in a current of hydrogen chloride, so that the vapours did not come into contact with organic matter until after passing through a cooled aqueous solution of hydrogen sulphide.

In dealing with a mixture containing arsenic in the two states of oxidation, the distillation was first carried out in hydrogen chloride, when the arsenious sulphide precipitated in the receiver represented the tervalent arsenic. On repeating the distillation of the residual liquid in a current of hydrogen chloride mixed with hydrogen sulphide a second precipitation of arsenious sulphide was obtained, this being derived from the arsenic originally present in the quinquevalent condition.

II. *The Estimation of Carbon by Oxidation with Chromic Acid.*—Phosphoric acid was substituted for sulphuric or hydrochloric acid in the gravimetric estimation of carbon dioxide in native carbonates, and when these substances contained organic matter, chromic acid was subsequently added to the contents of the distilling flask and the operation repeated, the second increase in weight of the tared absorption tube being due to the oxidation of the organic carbon.

The mixture of chromic and phosphoric acids was also used in estimating the total carbon in cast iron and ferromanganese, the employment of a non-volatile acid instead of sulphuric acid obviating the risk of carrying over acid fumes into the weighed absorption tube.

129. "Nitrogen chlorides containing two halogen atoms attached to the nitrogen." By Frederick Daniel Chattaway.

Very few substituted nitrogen chlorides containing two halogen atoms attached to a single nitrogen atom have been prepared, the best known being those derived from the primary alkylamines.

Stable, well-crystallised compounds having the general formula $RSO_2\cdot NCl_2$ are yielded by all the sulphonamides, and a few have already been described by Kastle, Keiser, and Bradley (*Amer. Chem. J.*, 1896, **18**, 491).

They are most easily prepared by dissolving the sulphonamides in a solution of bleaching powder and adding acetic acid, when they separate as crystalline solids.

The dichloroaminosulphonamides are not easily hydrolysed even by boiling with water; they dissolve in caustic alkalis, apparently yielding salts of the monochlorosulphonamides, which can be recrystallised from water. With hydrochloric acid, hydriodic acid, or alcohol, they react vigorously, the sulphonamides are regenerated, and chlorine, iodine, or ethyl hypochlorite is liberated. On heating rapidly, the dichlorosulphonamides decompose with slight explosion, whilst the tetrachlorodisulphonamides explode with great violence. This behaviour is noteworthy, as the latter compounds are the only substituted nitrogen chlorides yet prepared which detonate in a way resembling the explosion of nitrogen chloride itself.

These compounds, as well as the chlorosulphonalkylamides and the corresponding bromine derivatives, are being further studied, as they are very reactive and promise to be of considerable value in organic synthesis. Moreover, the dichlorosulphonamides are so easily prepared, crystallised, and analysed that they may prove of considerable use in the investigation of sulphonic acids.

The following compounds were described:

Benzenesulphondichloroamide, $C_6H_5{\cdot}SO_2{\cdot}NCl_2$, colourless plates, m. p. 76°; *p*-toluenesulphondichloroamide, $CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl_2$, long, four-sided prisms, m. p. 83° (Kastle, Keiser, and Bradley, *loc. cit.*); *o*-toluenesulphondichloroamide, $CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl_2$, colourless plates, m. p. 33°; *m*-nitrobenzenesulphondichlorodiamide, $NO_2{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl_2$, faintly yellow, six-sided plates, m. p. 121°; *o*-nitrotoluene-*p*-sulphondichloroamide, $CH_3{\cdot}C_6H_3(NO_2){\cdot}SO_2{\cdot}NCl_2$ (1 : 2 : 4), pale yellow, four-sided prisms, m. p. 101°; benzene-*m*-disulphontetrachloroamide, $C_6H_4(SO_2{\cdot}NCl_2)_2$, colourless rhombs, m. p. 128°; naphthalene-1-sulphondichloroamide, $C_{10}H_7{\cdot}SO_2{\cdot}NCl_2$, pale yellow plates, m. p. 91°; naphthalene-2-sulphondichloroamide, colourless plates, m. p. 68°; naphthalene-2 : 7-disulphontetrachloroamide, $C_{10}H_6(SO_2{\cdot}NCl_2)_2$, clusters of colourless pyramids, m. p. 165°; anthraquinone-2-sulphondichloroamide, $C_{14}H_7O_2{\cdot}SO_2{\cdot}NCl_2$, yellow plates, m. p. 177°.

130. "Sulphonphenylchloroamides and sulphontolylchloroamides."

By Frederick Daniel Chattaway.

In a paper on the action of sodium hypochlorite on the aromatic sulphonamides, Raper, Thomson, and Cohen (*Trans.*, 1904, 85, 371) state that they were unable to obtain benzenesulphonphenylchloroamide, which was too unstable to be isolated in a pure state. This and other similar compounds can, however, easily be obtained if precautions are taken to avoid the presence of catalytic agents which bring about transformation. They are well-crystallised, comparatively stable substances, and show the characteristic behaviour of chloroamino-derivatives. The method of preparation and the properties of benzenesulphonphenylchloroamide and of a number of similar compounds were described.

131. "Stereoisomeric glucoses and the hydrolysis of glucosidic acetates." By Edward Frankland Armstrong and Paul Seidelin Arup.

The results obtained on hydrolysing several of the glucosidic acetates by alkali were described and discussed in the light of the evidence recently brought forward regarding the stereoisomeric glucoses. It was shown that the acetyl groups are removed with unequal readiness from the penta-acetates of glucose and galactose and from sucrose octoacetate, and with equal readiness from the tetra-acetates of the methylglucosides and galactosides. Kreman's observation (*Monatsh.*, 1902, 23, 479) that the two isomeric penta-acetates of glucose are hydrolysed at equal rates is confirmed.

132. "The colouring matter of the flowers of Butea frondosa." By Arthur George Perkin.

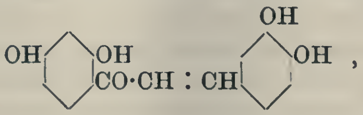
In a former communication (J. J. Hummel and A. G. Perkin, *Proc.*, 1903, 19, 134), it was considered probable that butein from *Butea frondosa* exists in a colourless, as well as in a yellow form. These modifications are, however, distinct substances. The colourless compound now termed *butin*, $C_{15}H_{12}O_5$, crystallising from alcohol in colourless needles and from dilute alcohol in pale yellow needles with $\frac{1}{2}H_2O$, melts at 224—226°. The *triacetyl* compound, $C_{15}H_9O_5(C_2H_3O)_3$, forms colourless leaflets (m. p. 123—125°), and the *benzoyl* compound, $C_{15}H_9O_5(C_7H_5O)_3$, colourless needles (m. p. 155—157°). On fusion with caustic alkali, butin gives resorcinol and protocatechuic acid, and at a lower temperature resacetophenone is also formed. By methylation, two isomeric *methyl ethers*, $C_{15}H_9O_2(OCH_3)_3$, are produced: (*a*) yellow leaflets (m. p. 156—158°) containing a free hydroxyl group, and (*b*) almost colourless, flat needles (m. p. 119—121°).

Butein, $C_{15}H_{12}O_5$, orange-yellow needles (m. p. 213—215°), crystallises from dilute alcohol with $1H_2O$; it is obtained in small quantity together with butin from the plant, and can be prepared from butin by the action of hot dilute caustic alkali or alcoholic potassium acetate; *acetylbutein*, $C_{15}H_8O_5(C_2H_3O)_4$, forms pale yellow needles (m. p

129—131°). On fusion with alkali, butein gives the same decomposition products as butin, and on methylation the same two trimethyl ethers, (*a*) m. p. 156—158°, and (*b*) m. p. 119—121°.

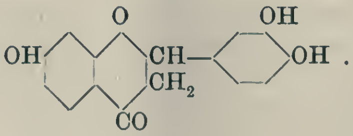
When digested with boiling dilute alcoholic sulphuric acid, butein is partially reconverted into butin, and by digesting the trimethyl compound (m. p. 119—121°), which is really butin methyl ether, with alcoholic potash and water it passes into the butein methyl ether (*a*) (m. p. 156—158°). Again, on digesting butein methyl ether with alcoholic sulphuric acid butin methyl ether is obtained.

Butein has the constitution of a *tetrahydroxybenzylideneacetophenone* (chalkone):



as proved by the synthesis of its trimethyl ether (m. p. 156—158°) by the condensation of veratric aldehyde with resacetophenone monomethyl ether.

Kostanecki and his colleagues (*Ber.*, 1904, **37**, 784) have shown that with dilute sulphuric acid chalkone methyl ethers give the corresponding flavanone compounds, and as both butein and its methyl ether in this way yield butin and its methyl ether respectively, there can be little doubt that butin has the following constitution:



133. "Cyanomaclurin." By Arthur George Perkin.

Cyanomaclurin (*Trans.*, 1895, **67**, 937) which exists in jackwood (*Artocarpus integrifolia*) in conjunction with morin, crystallises from water in the anhydrous form, and is now shown to be isomeric with the catechins, $C_{15}H_{14}O_6$; it forms a *penta-acetyl* compound,

$$C_{15}H_9O_6(C_2H_3O)_5,$$

separating in colourless needles (m. p. 136—138°), a *pentabenzoyl* compound forming colourless prisms (m. p. 171—173°), and the *azobenzene* derivative, $C_{15}H_{12}O_6(C_6H_5N_2)_2$ (m. p. 245—247°), gives an *acetyl* compound melting at 209—210°. On fusion with caustic alkali, cyanomaclurin gives β-resorcylic acid (not cresorcylic acid as previously suggested) and phloroglucinol, and with pine wood and hydrochloric acid it resembles the catechins in giving the phloroglucinol reaction.

With boiling dilute hydrochloric acid, a brown amorphous compound is produced; this is identical in appearance with the so-called fourth anhydride from Gambier catechin, and has the same percentage composition.

Cyanomaclurin thus appears to represent a catechin in which the catechol nucleus is replaced by resorcinol.

134. "The determination of acetyl groups." By Arthur George Perkin.

The substance (approximately 0·5 gram) in 30 c.c. alcohol is distilled with 2 c.c. of sulphuric acid, a little fresh alcohol being added from time to time. The distillate is collected in standard alcoholic potash, and this is boiled in order to saponify the ethyl acetate present, the mixture being subsequently titrated with sulphuric acid. The operation is complete in about an hour and sufficiently accurate for general use. The following results have been obtained:

Acetylalizarin	gave acetic acid	= 37·59.	Theory	37·04.
Acetylquercetin	,,	= 58·44.	,,	58·59.
Acetylpurpurogallin	,,	= 62·40.	,,	61·86.
Acetylcatechin (m. p. 129—130°)	,,	= 60·18.	,,	60·00.
Acetylcatechin (m. p. 158—160°)	,,	= 60·24.	,,	60·00.
Acetylbutin	,,	= 45·60, 45·34.	,,	45·23.

With acetanilide and its homologues reliable results are also obtained, employing, however, 4 c.c. of sulphuric acid, and longer distillation. Thus acetanilide itself gave acetic acid = 44·74 and 44·55 per cent., whereas theory requires 44·44. It has been previously shown that, with alcoholic potassium acetate, acetyl derivatives of the phenols evolve ethyl acetate. This process can be employed for acetyl determinations in some instances, and is still under investigation, but as yet has not been successful in all cases. By this means acetylbutin gave 45·60 (p. 169) and acetylbutein 54 per cent.; in the latter case the theory requires 54·54 per cent.

135. "Note on the catechins." By Arthur George Perkin.

In a previous communication (*Trans.*, 1902, 81, 1160) it was pointed out that whereas Gambier catechu contains a catechin, $C_{15}H_{14}O_6$ (m. p. 175—177°), the pentabenzoyl derivative of which melts at 151—153°, yet a catechin, $C_{15}H_{14}O_6$, which was isolated from *Acacia catechu* melted at 204—205°, and gave a benzoyl compound, melting at

181—183°. It is now found that the acacia catechin gives an acetyl derivative, $C_{15}H_9O_6(C_2H_3O)_5$, forming colourless needles (m. p. 158—160°), and a tetramethyl ether, $C_{15}H_{10}O_2(OCH_3)_4$, separating in colourless prisms (m. p. 152—153°). The corresponding substances from the Gambier catechin (Kostanecki and Tambor, *Ber.*, 1902, **35**, 1867), melt at 129—130° and at 142—143°, respectively. For acacia catechin the name "*acacatechin*" is proposed.

136. "A constituent of Java indigo." By Arthur George Perkin.

Rawson (*J. Soc. Dyers and Colourists*, 1899, **15**, 129) has shown that Java indigo contains a yellow colouring matter. This substance, $C_{15}H_{10}O_6$, forms yellow needles, melts at 276—277°, and gives an acetyl compound, $C_{15}H_6O_6(C_2H_3O)_4$, which separates in colourless needles and melts, when crystallised from methyl alcohol, first at 116—120° and subsequently at 181—182°. The colouring matter is identical with kampherol (*Trans.*, 1902, **81**, 587).

LIST OF FELLOWS.

As the List of Fellows for 1904 is now in active preparation, no change of address received after **July 30th** can be included in it.

THE LIBRARY.

The Library will be closed for Stock-taking from **Monday, August 8th**, until **Saturday, August 20th**, 1904, inclusive.

Fellows are particularly requested to return all books belonging to the Library **not later than Wednesday, August 3rd.**

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Issued 12/11/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 284.

The following are abstracts of papers received during the vacation and published or passed for publication in the *Transactions*.

137. "The action of chromyl chloride on stilbene, styrene, and phenanthrene." By George Gerald Henderson and Thomas Gray.

Each of the hydrocarbons, stilbene, styrene, and phenanthrene, when treated with chromyl chloride in carbon disulphide solution, yields a solid, brown additive compound. These solids are decomposed by water, and oxidation products of the hydrocarbons are liberated. Stilbene is oxidised to benzil, and, with partial decomposition, to benzophenone and benzaldehyde. Styrene yields benzaldehyde as the chief product, together with a trace of phenylacetaldehyde and a small amount of a chlorinated compound. The sole product obtained from phenanthrene was phenanthraquinone.

138. "The stereoisomeric tetramethyl methylglucosides and tetramethyl glucose." By Thomas Purdie and James Colquhoun Irvine.

The pentamethyl glucose (m. p. 42—43°) obtained from tetramethylglucose, either by the silver oxide method of alkylation or by the action of methyl alcohol containing hydrogen chloride (*Trans.*, 1903, **83**, 1035), proves to be *tetramethyl-β-methylglucoside*; the stereoisomeric liquid *α*-glucoside is produced simultaneously, but in much smaller proportion. The β-glucoside is characterised by its lævorotatory power, its more rapid hydrolysis by hydrochloric acid, and its susceptibility to the hydrolytic action of emulsin.

In aqueous solution, tetramethyl glucose, like glucose itself, exhibits phenomena of multirotation. The α-form (m. p. 88—89°; $[\alpha]_D^{20°}$ + 100·8°) is obtained by repeated crystallisation of the crude aldose from petroleum; the β-form (Tanret's γ-form), or at least a mixture containing a large excess of it ($[\alpha]_D^{20°}$ 73·1°), is produced by heating the α-form above its melting point. The modification, which is stable in solution ($[\alpha]_D^{20°}$ 83·3°), is apparently a mixture of the two dynamic isomerides. In the solid state, the β-isomeride reverts to the α-form.

Multirotation was also observed in benzene and carbon tetrachloride, and therefore neither ionisation nor the formation of hydrates or compounds of the acetal class is essential for the occurrence of this phenomenon.

139. "The alkylation of galactose." By James Colquhoun Irvine and Adam Cameron.

The silver oxide method of alkylation, when applied to α-methylgalactoside, gives rise to tetramethyl α-methylgalactoside, a colourless, refractive liquid (b. p. 136—137°/11 mm., $[\alpha]_D^{20°}$ of the pure liquid is + 105·7°, and in aqueous solution $[\alpha]_D^{20°}$ is + 143·4°). Hydrolysis with hot dilute hydrochloric acid leads to the production of tetramethyl galactose, a colourless, refractive syrup (b. p. 172°/13 mm.). After distillation, the alkylated sugar displays multirotation, not only in water, but also in alcohol and benzene, the permanent values for these three solvents being + 109·5°, 62·6°, 90·0° respectively. In other respects, also, the behaviour of the compound supports the view that it has an oxidic structure.

When the substance is either heated with methyl alcohol and hydrochloric acid or treated with silver oxide and methyl iodide, the stereoisomeric tetramethyl α- and β-methylgalactosides are produced, the latter method giving a large excess of the β-compound, whilst the former yields a greater proportion of the α-isomeride. The crystalline β-form (m. p. 44—45°) is much more readily hydrolysed than its isomeride, either by dilute acids or by emulsin.

140. "A method for the rapid ultimate analysis of certain organic compounds." By John Norman Collie.

The method consists in burning the substance in a known volume of oxygen, noticing any change in the volume of the gas, and then, by absorbing the carbon dioxide produced, data sufficient for the calculation of the percentage amounts of carbon and hydrogen are obtained.

Only those substances can be estimated which are not appreciably volatile in a vacuum, and which contain only carbon and hydrogen or carbon, hydrogen, and oxygen. The time required for an analysis is only about an hour; the amount of substance used can be reduced to nearly one-tenth of that ordinarily employed, and as the measurements depend on volumes of gases the method is very accurate.

141. "The comparative nitrifying power of soils." By Sydney Francis Ashby.

The method devised for comparing quantitatively the power of cultivated soils to convert their ammonia into nitrites and nitrates has justified itself by:—

(1) Yielding samples giving reasonably similar nitrifying power from different parts of the same field.

(2) Causing equal seedings from the same sample to show similar nitrifying power.

(3) Minimising loss of nitrogen by volatilisation of ammonia and denitrification during incubation.

(4) Limiting the incubation period to about 30 days.

(5) Showing a nitrifying power of the soils tested which corresponds with their fertility as gauged from manuring and crop production.

142. "The action of organic bases on olefinic ketonic compounds." By Siegfried Ruhemann and Edwin Roy Watson.

Benzylideneacetylacetone readily unites with *m*-toluidine, *p*-toluidine, *m*-chloroaniline, *p*-chloroaniline, *β*-naphthylamine, and piperidine, but it does not combine with *o*-toluidine, *a*-naphthylamine, or tetrahydroquinoline.

Piperidinobenzylacetylacetone, $C_6H_5 \cdot CH(NC_5H_{10}) \cdot CH(CO \cdot CH_3)_2$, is stable in a dry atmosphere, but in the presence of moisture it gradually decomposes with the formation of benzylidenebisacetylacetone, benzaldehyde, and piperidine.

The production of benzylidenebisacetylacetone and similar compounds from benzaldehyde and ketonic compounds is therefore preceded by the formation of additive compounds of piperidine with olefinic ketonic compounds. This view is supported by the fact that benzylideneacetylacetone, which combines with piperidine, also condenses with acetylacetone in the presence of the base to form benzylidenebisacetylacetone, whilst no such reaction takes place if tetrahydroquinoline, which does not form an additive compound with the olefinic ketone, is used instead of piperidine.

With phenylhydrazine, dibenzylideneacetone forms the phenylhydrazone, $(C_6H_5CH{:}CH)_2C{:}N{\cdot}NH{\cdot}C_6H_5$, and not an additive compound; with ammonia, it yields a mixture of substances from which has been isolated the compound having the formula $C_{34}H_{35}N_3$.

Benzylideneacetophenone dibromide, when condensed with ammonia, yields aminobenzylideneacetophenone, $C_6H_5{\cdot}C(NH_2){:}CH{\cdot}CO{\cdot}C_6H_5$, it therefore follows that the corresponding compound obtained by Wieland (*Ber.*, 1894, 27, 1150) from ammonia and *p*-nitrobenzylideneacetophenone dibromide is also unimolecular.

143. "Halides of the acridines and naphthacridines." By Alfred Senier and Percy Corlett Austin.

The halogens combine directly with the acridines, forming a series of well-defined, crystalline compounds, which are sparingly soluble in organic media, and are obtained by mixing the reagents either alone or in a suitable solvent. The products, which have characteristic colours, are unstable, especially in presence of water. The fluorescence, when in solution, which is so marked a character of acridines generally, and which depends on the presence of the acridine "fluorophore," is absent, except in three instances.

That these compounds are not substitution derivatives follows from their instability, the small number of halogen atoms which they contain, and the fact that no acridone is formed when they are treated with water or alkalis. They are therefore additive compounds, namely, halides. Moreover, the addition takes place in the acridine ring, for, were it otherwise, monadic atoms would be added only in pairs, which, however, is not the case, and a higher number would combine owing to the disruption of the centric benzene linkings.

Adopting this view, two formulæ are possible for the dihalides. The first, which is of the type of the dihydrides or dihydroacridines (Bernthsen and Bender, *Ber.*, 1883, 18, 1802), is suggested for the non-fluorescent dihalides, and the second, corresponding with the acridinium salts, alkylhalides, and alkylhydroxides, is employed for the dihalides which exhibit fluorescence. In accordance with the foregoing hypothesis, the tetrahalides should have formulæ of the former non-fluorescent type, and acridine tetrabromide, the only tetrahalide described, was found to be non-fluorescent.

Those compounds which contain one halogen atom combined with one and three molecular proportions of base respectively are regarded as being products intermediate between the bases and the dihalides, in the one case, and the dihalides and tetrahalides in the other, and to these products dimolecular formulæ are assigned.

144. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part II. Cyanohydrins regarded as complex acids." By Arthur Lapworth.

Under certain conditions, an aqueous solution of potassium cyanide readily dissolves benzaldehyde and camphorquinone. From the resulting liquids, crystalline additive products having approximately the compositions $C_7H_6O,KCN,2\frac{1}{2}H_2O$ and $C_{10}H_{14}O_2,KCN,3H_2O$ have been isolated. These substances behave as salts of the corresponding cyanohydrins, which are probably much feebler acids than hydrocyanic acid itself.

145. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part III. Action of potassium cyanide on mesityl oxide." By Arthur Lapworth.

It was shown that when mesityl oxide is heated with potassium cyanide dissolved in dilute alcohol, hydrogen cyanide is first assumed at the ethylenic carbon linking, and that the potassium hydroxide which is simultaneously produced converts the product into mesitonic acid; more prolonged heating results in the formation of mesitylic acid, which necessitates the addition of a second molecule of hydrogen cyanide in this case to the carbonyl group, and the subsequent hydrolysis of the product.

146. "6-Aminocoumarin." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

6-Aminocoumarin, although resembling the naphthylamines in containing two unsaturated rings, nevertheless behaves towards diazonium salts like a para-substituted benzenoid amine, giving rise to stable diazoamino-derivatives.

This base and its mono- and di-alkylated compounds and the corresponding hydrazine and diazocyanide are all coloured substances, whereas the salts of these bases, the acyl derivatives of the primary and secondary amines, the nitrosoamines of the monoalkyl derivatives, the diazonium salts of the parent base and its quaternary bromides and iodides are colourless.

147. "Studies in asymmetric synthesis. I. Reduction of menthyl benzoylformate. II. Action of magnesium alkyl haloids on menthyl benzoylformate." By Alexander McKenzie.

When *l*-menthyl *dl*-mandelate is hydrolysed by an amount of potassium hydroxide insufficient for complete hydrolysis, an optically active mandelic acid is invariably obtained from the potassium salt thus formed. The mixture of esters remaining after this partial hydrolysis, when completely hydrolysed, yields mandelic acid which is either optically active or inactive, according to the experimental conditions. In the complete hydrolysis, by potassium hydroxide, of a mixture of *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate containing an excess of either of those esters, racemisation phenomena are observed.

On reducing menthyl benzoylformate to menthyl mandelate and hydrolysing the latter, the mandelic acid obtained was inactive. But it does not follow from this result that equal amounts of *l*-menthyl *d*-mandelate and *l*-menthyl *l*-mandelate were present in the product obtained by the reduction of menthyl benzoylformate, since, even if unequal amounts had been present, the mandelic acid obtained might still have been inactive owing to the racemising effect of the hydrolysing alkali.

Further investigation showed that a slight excess of *l*-menthyl *l*-mandelate was present in the reduction product, which, however, on hydrolysis, yielded *r*-mandelic acid.

When menthyl benzoylformate, $PhCO\cdot CO_2\cdot C_{10}H_{19}$, is acted on by magnesium methyl iodide and the magnesium addition compound then decomposed by water and dilute acid, a new asymmetric carbon atom is produced. In this instance, no racemising effects are observed on hydrolysing the product with alkali, since an optically active potassium salt is present in solution after the complete removal of the *l*-menthol, and this salt yields an optically active phenylmethylglycollic acid, $CMePh(OH)\cdot CO_2H$. An optically active phenylethylglycollic acid was also obtained in a similar manner.

That the optical activity exhibited by phenylmethylglycollic and phenylethylglycollic acids, prepared by Grignard's reaction, was actually due to their asymmetric synthesis was shown by preparing diphenylglycollic (benzilic) acid from menthyl benzoylformate and magnesium phenyl bromide. In this case, where a new asymmetric carbon atom was not produced, the resulting acid was inactive.

148. "The relation of position isomerism to optical activity. II. The rotation of the menthyl esters of the isomeric chlorobromobenzoic acids." By Julius Berend Cohen and Henry Stanley Raper.

The authors have extended the research of Briggs and Cohen on the relation of position isomerism to the rotations of the menthyl esters of the six dichlorobenzoic acids (*Trans.*, 1903, **83**, 1213) by preparing and examining the menthyl esters of the ten isomeric chlorobromobenzoic acids.

The molecular rotations of these esters agree in a very satisfactory way with those of the dichlorobenzoic esters.

The greatest effect in decreasing the rotation is produced when the halogen enters the ortho-position with respect to the ester group; the least when both halogens are in the meta-position. The mean order of magnitude, beginning with the ester of lowest rotation, is as follows:

2 : 6; 2 : 3; 2 : 5; 2 : 4; 3 : 4; 3 : 5; phenyl,

which is precisely the order of rotation of the dichloro-esters.

When the chlorine is nearer to the ester group than the bromine, a greater depression in the rotation is produced than by the reverse arrangement. Moreover, when the chlorine occupies the ortho-position to the ester group, the rotation is lower than that of the corresponding dichloro-ester. The general effect of bromine is to influence the rotation less than the chlorine—a result which seems to follow from the effect of the monohalogen esters.

The great contrast afforded by the two symmetrical compounds of both series, namely, the 3 : 5- and 2 : 6-esters, is not a little remarkable, and these isomerides may be regarded as the first and last terms of a series in which the 2 : 6-compounds have a high melting point and low rotation, whilst the 3 : 5-isomerides have a low melting-point, low density, and high rotation.

149. "The relation of position isomerism to optical activity. III. The rotation of the menthyl esters of the isomeric iodobenzoic acids." By Julius Berend Cohen and Henry Stanley Raper.

In a former communication (Cohen and Briggs, *Trans.*, 1903, **83**, 1216), the rotations of the menthyl esters of the three monochlorobenzoic acids were given and compared with the constants obtained for the monobromobenzoic esters by Tschugaeff. The authors have now determined the constants for the menthyl esters of the three iodobenzoic acids.

150. "The chlorination of the trichlorotoluenes in presence of the aluminium-mercury couple. The constitution of the tetrachlorotoluenes. Part V." By Julius Berend Cohen and Henry Drysdale Dakin.

In previous papers (Part III., *Trans.*, 1901, 79, 1111; Part IV., *Trans.*, 1902, 81, 1325), the authors have traced the progressive chlorination of toluene as far as the formation of the trichlorotoluenes. The products formed on introducing a fourth chlorine atom into each of the six trichlorotoluenes have now been investigated.

On chlorinating 3 : 4 : 5-trichlorotoluene at 0°, the chlorine enters the side-chain instead of the nucleus.

Although there appears to be no general law determining the position of the fourth entrant chlorine atom, yet there exists a remarkable agreement between the positions taken by the entrant chlorine atoms and nitro-groups when the first two chlorine atoms have been introduced into either benzene or toluene. Whatever the ultimate explanation may be, it is clear that after the first two chlorine atoms have been introduced into benzene and toluene the special rules which usually govern substitution are wholly or in part set aside in favour of a more general law which includes both the substituent chlorine atom and also the nitro-group.

151. "The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds. Part I. Alkyl haloids." By Arthur Slator.

The reactions between sodium thiosulphate and methyl, ethyl, and ethylene haloids have been investigated in dilute solution and shown to be in most cases bimolecular, thus: $CR_3I + S_2O_3'' = CR_3S_2O_3' + I'$. Water was used as a solvent whenever possible, but in a few cases a mixture of this liquid and alcohol had to be employed.

The rate of reaction is approximately trebled for a rise of 10°. The velocity-coefficients may be used to compare the reactivities of these haloids. With two of the compounds (C_2H_4ICl, C_2H_4BrCl), the velocity of the reaction with excess of thiosulphate is independent of this excess and the reaction is therefore unimolecular. To explain this result, it is suggested that the haloids are capable of existing in two tautomeric forms, and that the measurable reaction represents the change of one form into the other.

152. "Note on methyl fluoride." By John Norman Collie.

Methyl fluoride under 2 mm. pressure, when contained in a vacuum tube having aluminium electrodes and subjected to the spark from an induction coil, gives a bluish-green colour. The spectrum, however, rapidly changes, and the characteristic lines of hydrogen make their appearance. When sparked under the ordinary pressure, the gas is almost immediately decomposed in the following manner: $4CH_3F = 4C + 4H_2 + 2H_2F_2$. In glass tubes, a secondary change occurs; the silicon fluoride formed by the action of the hydrogen fluoride on the glass is reduced by the hydrogen, and silicon is deposited: $SiF_4 + 2H_2 = 2H_2F_2 + Si$.

153. "Acetylenic ketones." By Edwin Roy Watson.

The action of various bases on bromobenzylideneacetophenone, $C_6H_5{\cdot}CBr{:}CH{\cdot}CO{\cdot}C_6H_5$, has been investigated in the hope that a molecule of hydrogen bromide might thereby be eliminated from this compound (compare Ruhemann and Watson, *Trans.*, 1904, 85, 457). The action of solid powdered potash gives rise to phenylacetylene, potassium benzoate, and potassium bromide.

The action of alcoholic ammonia gives rise to aminobenzylideneacetophenone, $C_6H_5{\cdot}C(NH_2){:}CH{\cdot}CO{\cdot}C_6H_5$, and by the action of piperidine two compounds, dipiperidinobenzylacetophenone and piperidinobenzylideneacetophenone, are produced. Strong bases replace the bromine atom in bromobenzylideneacetophenone by an amino- or substituted amino-group.

Phenylpropiolyl chloride reacts readily with anisole to produce the expected acetylenic ketone, methoxybenzoylphenylacetylene. On substituting benzene for anisole the simple reaction no longer occurs, but several substances are produced, including a hydrocarbon having the empirical formula $C_{14}H_{12}$.

Methoxybenzoylphenylacetylene and piperidine yield piperidinomethoxybenzoylstyrene, $C_6H_5{\cdot}C(NC_5H_{10}){:}CH{\cdot}CO{\cdot}C_6H_4{\cdot}O{\cdot}CH_3$, whilst the action of hydroxylamine gives rise to 1-phenyl-3-methoxyphenyl-*iso*oxazole.

Benzoylphenylacetylene yields the phenylhydrazone,

$$C_6H_5{\cdot}C{⋮}C{\cdot}C({:}N{\cdot}NH{\cdot}C_6H_5){\cdot}C_6H_5,$$

and the anilinobenzoylstyrene, $C_6H_5{\cdot}C(NH{\cdot}C_6H_5){:}CH{\cdot}CO{\cdot}C_6H_5$, when treated with phenylhydrazine and aniline respectively.

154. "Note on bergamot oil and other oils of the citrus series." By Herbert Edward Burgess and Theodore Henry Page.

Acetic acid, octylene, pinene, camphene, and limene have been identified as constituents of a specimen of pure oil of bergamot. The pungency of the first fractions of this oil on distillation is accounted for by the acetic acid, which was also found in smaller quantities in lemon oil and is probably present in the other oils of this series.

The octylene found in lemon oil was identical with that in bergamot oil, for both gave butyric acid on oxidation with potassium permanganate. It is probably a normal constituent of the citrus oils. A second phenylurethane isolated from the terpineol fraction of distilled oil of limes melts at 132°, is more soluble than that obtained from ordinary terpineol, crystallises in tufts of needles, and gives on hydrolysis an oil with an intense odour of distilled oil of limes.

155. "The resolution of externally compensated dihydro-α-methylindole." By William Jackson Pope and George Clarke, jun.

On crystallising externally compensated dihydro-α-methylindole with *d*-bromocamphorsulphonic acid, *l*-dihydro-α-methylindole *d*-bromocamphorsulphonate, $C_9H_{11}N,C_{10}H_{14}BrO{\cdot}SO_3H$, first separates, and on purification crystallises in needles (m. p. 179·5—180·5°; $[M]_D+278°$ in aqueous solution). With caustic soda, it yields *l*-dihydro-α-methylindole, which is obtained as a colourless oil (b. p. 228—229°; $[\alpha]_D-13{\cdot}61°$ in a 1 dcm. tube). The base is dextrorotatory in ethyl alcohol and benzene solutions, but lævorotatory in ethereal solution.

A more sparingly soluble dihydro-α-methylindole *d*-bromocamphorsulphonate (m. p. 124—125°) accompanies the above salt, but, although it has the low molecular rotatory power of $[M]_D+242{\cdot}6°$ in aqueous solution, corresponding with the presence of a basic ion of $[M]_D-30°$, this salt yields inactive base and inactive benzoyl and acetyl derivatives.

On adding caustic soda to the final mother liquors obtained during the resolution, impure *d*-dihydro-α-methylindole separates, but was not obtained free from the lævo-isomeride; its benzoyl and acetyl derivatives were, however, prepared in a state of purity, and have properties corresponding with those of their optical antipodes.

156. "The vapour pressures of sulphuric acid solutions and the molecular condition of sulphuric acid in concentrated solution." By Bryce Chudleigh Burt.

The vapour pressures of sulphuric acid solutions of various concentrations (from 25 to 95 per cent. H_2SO_4) have been determined by an ebullioscopic method. The values so obtained lie on smooth curves when plotted against temperature and concentration. The molecular weight has been calculated from Raoult's corrected formula:

$$m = M.\frac{g}{G}.\frac{p'}{p-p'},$$

where m = molecular weight of solute; M = molecular weight of solvent in the gaseous state; g = weight of solute; G = weight of solvent; p = vapour pressure of pure solvent; p' = vapour pressure of solution. The values for m obtained vary over very wide limits, increasing with rise of temperature and decreasing with increase in concentration. The different values do not lie on smooth curves when plotted against temperature and concentration.

These abnormalities can only be explained by supposing that combination occurs between the solvent and solute with the formation of complex molecules, the formation of such complexes being favoured by an increase in concentration but not by a rise in temperature.

157. "Reactions involving the addition of hydrogen cyanide to carbon compounds. Part IV. Addition of hydrogen cyanide to benzylideneacetophenone." By Archie Cecil Osborn Hann and Arthur Lapworth.

The addition of hydrogen cyanide to benzylideneacetophenone takes place only in presence of a considerable quantity of potassium cyanide, and the failure of Rupe and Schneide (*Ber.*, 1895, 28, 957) to bring about the addition process is thus explained. When the solution is but feebly alkaline, the product is β-benzoyl-α-phenylpropionitrile, $CHPh(CN){\cdot}CH_2{\cdot}COPh$, but in presence of alkali the latter condenses with unaltered benzylideneacetophenone to yield the compound $C_{31}H_{23}ON$, which Rupe and Schneide obtained in small quantities.

The *oxime*, $CHPh(CO_2H){\cdot}CH_2{\cdot}CPh{:}N{\cdot}OH$, when warmed with sulphuric acid, undergoes the Beckmann change, yielding phenylsuccinic acid and aniline, by which reaction the constitution of the ketonic acid is established.

By means of the quinine salt, β-benzoyl-α-phenylpropionic acid was resolved into its optical isomerides; the *lævo*-acid, melting at 176—178° in 6 per cent. ethyl acetate solution, had $[\alpha]_D - 157{\cdot}57°$, whilst the *dextro*-acid had $[\alpha]_D + 157{\cdot}3°$.

158. "The bromination of silver cyanate." By George Dean.

Silver cyanate, when treated with an equivalent weight of bromine in a sealed tube, yielded a yellow product, AgCNOBr. The substance, which did not darken on exposure to light, gave off bromine when heated above 70°. At 300—400°, the bromine evolved from the substance was accompanied by a thick sublimate of cyanogen bromide. The substance dissociated under 10—20 mm. pressure. Water acts on the compound, yielding silver bromide, cyanuric acid, carbon dioxide, and nitrogen; hydrochloric acid gives rise to a mixture of silver chloride and bromide, whilst cyanogen chloride, bromine, and oxygen are eliminated. The compound oxidises alcohol to acetaldehyde. When the cyanate was brominated at a lower temperature, much more halogen was absorbed; the product, however, was readily decomposed in a current of air, leaving the less brominated compound.

159. "The decomposition of chloral hydrate by sodium hydroxide and by certain salts." Emil Alphonse Werner.

It is shown that the quantity of chloral hydrate decomposed by sodium hydroxide is a function of the temperature, for one molecular proportion of this alkali is capable of decomposing from one to four molecular proportions of the hydrate with production of chloroform, sodium formate, and free formic acid. Sodium acetate and similar salts are also capable of decomposing the hydrate with the production of formic acid. Water and dilute acids do not decompose chloral hydrate in this manner.

Two alternative theories are put forward to explain the decomposition. Firstly, it is assumed that a sodium derivative, $CCl_3{\cdot}CH(ONa){\cdot}OH$, formed on adding the alkali or salt, is immediately decomposed into chloroform and sodium formate. The decomposition of relatively large proportions of the hydrate by sodium hydroxide is easily explained in this way.

Secondly, the production of "nascent" carbon monoxide, $>\!C{:}O$, as distinct from $C{\vdots}O$, is suggested, this hypothetical substance then uniting with water to give formic acid.

160. "Contributions to the history of glyoxylic acid." By Heinrich Debus.

Two views still prevail with regard to the formula of glyoxylic acid: some chemists represent its composition by the formula $C_2H_2O_3,H_2O$, whilst others prefer the expression $C_2H_4O_4$. The author, after discussing the arguments in favour of each formula, comes to the conclusion that the formula $C_2H_2O_3,H_2O$ is more in harmony with the properties of glyoxylic acid than the other.

Some basic salts of glyoxylic acid are described which readily decompose into the corresponding glycollates and oxalates.

161. "The colouring matters of the stilbene group. I." By Arthur George Green.

The colouring matters of the stilbene class cannot have the simple structure assigned to them either by O. Fischer and Hepp or by Bender and Schultz. Apart from the general improbability that substances so constituted would have dyeing properties, the following facts indicate that they have a more complex structure :—

(1) Colouring matters can be obtained from *p*-nitrotoluenesulphonic acid by condensation with alkalis under suitable conditions, which, although having the general characteristics of Curcumine S or Direct Yellow, contain aldehydic groups in addition to the stilbene group.

(2) Stilbene dyes of mixed type can be obtained by condensing dinitrostilbenedisulphonic acid with aromatic amines under the influence of alkalis.

(3) Curcumine or Direct Yellow does not give rise on oxidation to dinitrostilbenedisulphonic acid, but furnishes a yellow dye of greener shade which is very similar to the first product of the alkaline reduction of dinitrostilbenedisulphonic acid.

The author has endeavoured to elucidate the constitution of the crimson-red compound which invariably precedes the formation of the stilbene colouring matter and is evidently the first phase of the condensation. The fact that this substance, on oxidation with hypochlorite, gives dinitrostilbenedisulphonic acid (Green and Wahl, *Ber.*, 1897, **30**, 3097) and is again regenerated from this acid on reduction, supported by a study of its phenyl ester and the analogous chloro-compound (compare next abstract), leads to the view that the crimson-red intermediate compound is a nitroso-stilbene or stilbene nitrolic acid having a quinonoid structure in alkaline solution.

162. "The colouring matters of the stilbene group. II." By Arthur George Green, Fred Scholefield, and Fred Marsden.

In order to elucidate the constitution of the crimson-red compound obtained on heating *p*-nitrotoluenesulphonic acid with caustic alkalis, and which forms the first phase of the stilbene condensation, the authors have investigated the behaviour of the corresponding phenyl ester, $C_6H_3(CH_3)(SO_3C_6H_5)(NO_2)[1:2:4]$, and chloro-compound, $C_6H_3(CH_3)Cl(NO_2)[1:2:4]$. The first of these compounds, in alcoholic solution, gives, on adding caustic soda, an intense bright blue coloration even in the cold ; the second gives a reddish-violet coloration at 20—30°.

It being found impracticable to isolate these coloured substances on account of their extreme instability, their behaviour on oxidation was studied. They are rapidly decolorised both by sodium hypochlorite and by air, and give rise to derivatives of dinitrostilbene. From the phenyl ester, a mixture of the *trans*- and *cis*-phenyl dinitrostilbenedisulphonates was produced. The same two compounds were also obtained from Green and Wahl's dinitrostilbenedisulphonic acid by conversion into the sulphonic chloride and treatment with sodium phenoxide. This fact serves to confirm the constitution assigned above, and also shows that the dinitrostilbenedisulphonic acid, and probably also the crimson-red intermediate compound and the stilbene colouring matters generally, must consist of mixtures of *trans-* and *cis-*isomerides.

The reddish-violet intermediate compound from *o*-chloro-*p*-nitrotoluene, on oxidation with air or sodium hypochlorite, yielded a mixture of *trans-* and *cis-*dichlorodinitrostilbenes; the yield of the two isomerides being nearly theoretical, the formation of a third substance is excluded and a simple connection between the coloured intermediate compound and the respective dinitrostilbene derivative is indicated. This is further supported by the fact that these dinitrostilbene derivatives are readily reconverted by alkaline reducing agents, such as phenylhydrazine and caustic soda, into the blue and reddish-violet compounds from which they are obtained. The authors are thus led to assign to the latter the structure of nitrosostilbenes or stilbene nitrolic acids.

163. "Researches on chromorganic acids: the behaviour of chromic hydroxide towards oxalic acid and certain other organic acids." By Emil Alphonse Werner.

An aqueous solution of oxalic acid, when saturated with chromic hydroxide, yields a deep purplish-red liquid, which, on evaporation, leaves a dark green residue, appearing almost black by reflected light. This compound has the properties of a true chromoxalic acid, $H_5Cr_4(C_2O_4)_6(OH)_5,4H_2O$, and yields an ammonium salt, $(NH_4)_5Cr_4(C_2O_4)_6(OH)_5,2H_2O$.

Whilst thoroughly washed chromic hydroxide is readily dissolved by oxalic acid in the proportion required by the formula $Cr_2(C_2O_4)_3$, this is not the case with other related organic acids. Under similar conditions, malonic acid dissolves approximately 50 per cent. of the calculated amount, whereas, with succinic acid, the interaction is inappreciable. A chromomalonic acid, having the formula $H_5Cr_4(C_3H_2O_4)_6(OH)_5,6H_2O$, analogous to the chromoxalic acid, was obtained, and also a chromomalonate, $K_2Cr_2(C_3H_2O_4)_4,10H_2O$, forming dark purplish-red crystals, the analogue of Croft's red chromoxalate.

The proportion of chromic hydroxide dissolved by malic, tartaric, tricarballylic, citric, glycollic, and lactic acids under the conditions described is relatively small, varying from a minimum of 12 per cent. (malic acid) to a maximum of 27 per cent. (lactic acid). In all these cases, chromorganic acids are produced, having, in general, properties resembling those of chromoxalic acid. With tartaric acid, a saline chromium tartrate, $Cr_2(C_4H_4O_6)_3$, is also formed. When the red salt, $K_2Cr_2(C_2O_4)_4,10H_2O$, is boiled in aqueous solution with 2 mols. of potassium oxalate, the blue chromoxalate, $K_6Cr_2(C_2O_4)_6,6H_2O$, is produced; a similar result is brought about by other salts, such as potassium acetate, malonate, or succinate, and so far no chromium compound containing two different acid groups has been obtained.

A well-defined potassium boro-oxalate, $K_2(Bo)_2(C_2O_4)_2,3H_2O$, which is readily obtained by boiling solutions of potassium metaborate and oxalic acid or boric acid and potassium hydrogen oxalate is described. A similar compound is not formed with malonic or succinic acid.

164. "The effect of colloidal platinum on mixtures of Caro's persulphuric acid with hydrogen peroxide." By Thomas Slater Price and John Albert Newton Friend.

Although solutions of hydrogen peroxide and Caro's acid have no appreciable action on each other, the addition of colloidal platinum causes interaction, oxygen being evolved, according to the equation $H_2SO_5 + H_2O_2 = H_2SO_4 + H_2O + O_2$, or $H_2S_2O_9 + 2H_2O_2 = 2H_2SO_4 + H_2O + 2O_2$. The rate of evolution of oxygen gives a measure of the velocity of the reaction; titration methods cannot be used, since there are no accurate methods of estimating hydrogen peroxide and Caro's acid in the presence of each other. It was found that, as long as the platinum was not precipitated out of the solution, the velocity constants, whether of the second or the third order (corresponding with the above equations), continually increased. This increase is considered to be due to two causes: (1) the gradual increase in the reactivity of the platinum during the reaction; (2) the independent and concurrent decomposition of the hydrogen peroxide and Caro's acid respectively. In some cases, the velocity curve was a straight line.

The effect of varying the concentration of the platinum was also studied, but no definite connection between concentration and velocity could be traced, except that a diminution in velocity was associated with a decrease in concentration of the platinum. In alkaline solutions, the results obtained were indefinite, since interaction takes place in the absence of platinum and the velocity seems to depend on the rate of stirring.

165. "The acylation of amides." By Arthur Walsh Titherley.

The conversion of a primary into a secondary amide and a secondary into a tertiary amide cannot, in general, be effected by treatment with acyl chlorides and anhydrides, but by first replacing the hydrogen of the $-CO\cdot NH_2$ or $-CO\cdot NH\cdot CO-$ group by sodium; the resulting sodium acylamide reacts usually with considerable energy with acyl chlorides or, preferably, anhydrides, yielding acylated derivatives. Sodium benzamide and benzoic anhydride, for example, yield sodium dibenzamide and benzoate. At the same time, a tertiary amide (tribenzamide) is formed owing to the interaction of a portion of the sodium dibenzamide and benzoic anhydride.

Although the action is normal in the aromatic and aliphatic series respectively, abnormal results are obtained on attempting to apply the method to the synthesis of mixed aliphatic aromatic secondary amides. Thus, neither sodium acetamide and benzoic anhydride nor sodium benzamide and acetic anhydride yield the expected acetylbenzamide in appreciable quantity, the main product of either of these condensations being sodium dibenzamide.

Cyclic anhydrides appear to behave normally. Thus, succinic anhydride and sodium benzamide give rise to *benzoylsuccinamic acid* (needles, m. p. 180°) and s-*dibenzoylsuccinamide* (m. p. 211°).

A further application of sodium acylamides for the purpose of acylation is based on their condensation with esters (*Trans.*, 1902, **81**, 1520), but the condensation is abnormal with esters and sodium acylamides which contain the groups $-CH_2 \cdot CO_2Et$ and $-CH_2 \cdot CO \cdot NHNa$ respectively. Methyl oxalate yields the disodium derivative of dibenzoyloxamide, but benzoyloxalimide, which was also anticipated, is not produced.

s-*Dibenzoyloxamide* (m. p. 227°) is readily soluble in sodium hydroxide, but the solution readily undergoes hydrolysis, forming benzamide and sodium oxalate. Ethyl succinate and sodium benzamide readily react, but do not yield either ethyl benzoyl succinamate, dibenzoylsuccinamide, or benzoylsuccinimide; the chief products are sodium succinimide and ethyl benzoate.

A very convenient process for acylating amides direct consists in treating directly with the acyl chloride the amide dissolved in pyridine (compare Freundler, *Compt. rend.*, 1902, **136**, 1553; 1903, **137**, 712—714). The method is limited in the same sense as the sodium acylamide anhydride method, since in this case also aromatic acyl radicles tend to displace aliphatic groups; hence it is impossible to prepare acetylbenzamide from benzoyl chloride and a pyridine solution of acetamide. That the method may be applied to the acylation of secondary as well as primary amides is shown by the fact that dibenzamide when subjected to this process yields 50 per cent. of tribenzamide.

Benzoylsuccinimide (m. p. 129—130°) is readily obtained by the action of benzoyl chloride on a pyridine solution of succinimide.

166. "The composition of beryl." By James-Holms Pollok.

The irregular results obtained on the analysis of compounds of glucina, prepared from various samples of the oxide, suggested that there was something in the composition of the beryl that had so far been overlooked.

The glucina employed was extracted from Limoges beryl during a previous research, and was known to give too high an equivalent, although analysis failed to indicate the presence of aluminium or any other base. This glucina was fractionated by crystallisation of the sulphate, by solution in ammonium carbonate, and by precipitation from hydrofluoric acid solution by potassium hydrogen fluoride. The glucina was recovered from the various fractions, converted into anhydrous chloride, and the various specimens of this salt analysed. In certain fractions, a progressive rise in the equivalent of the base was observed, giving figures ranging from 4·77 to 8·17.

Samples of glucinum chloride were then fractionated by distillation, the most volatile and least volatile portions being analysed separately. Three samples of the most volatile portions yielded equivalents of 9·08, 10·81, and 11·29.

Other fractions obtained by collecting the chloride that was first formed, apart from that which distilled over later, gave, on analysis, equivalents of 12·30, 14·80, and 18·74.

Only a small quantity of the chloride with the highest equivalent was obtained; the most careful analysis failed to detect in it the presence of aluminium, iron, or any other element, the sample having the chemical properties of glucinum only.

A spectroscopic examination of the various specimens with high equivalents showed that certain lines, only faintly visible in ordinary samples of glucina, became steadily stronger as the equivalent increased, and the known lines of glucinum became somewhat fainter.

These results indicate that beryl contains a new element having in the main the chemical properties of glucinum, but a much higher equivalent; its chloride is more volatile and more readily formed than that of glucinum, and the oxide is not so readily precipitated from a hydrofluoric acid solution by potassium hydrogen fluoride.

Thursday, November 3rd, 1904. Prof. W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. C. R. Beck, J. H. Johnston, R. Lessing, J. Marsh, and H. S. Shelton were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Walter Henry Bentley, B.A., 18, Oaten Hill, Canterbury.
John Wyclif Black, 20, Mardale Crescent, Edinburgh.
Thomas Story Busher, B.A., Queen's College, Oxford.
Lawrence Caldecott, 47, Woburn Place, Russell Square, W.C.
Robert John Caldwell, B.Sc., A.C.G.I., 49, Merritt Road, Crofton Park, S.E.
Peter Skinner Clark, M.B., Ch.M., Cape Town, Cape Colony, South Africa.
Frederick Clarkson-Harold, 10, Fee's Terrace, Longford, Ireland.
Robert Cornthwaite, Agricultural Laboratory, Halifax.
William Crabb, B.Sc., The Grammar School, Penistone, Yorks.
James Edward Cunningham, A.R.C.S., 21, Blenheim Gardens, Willesden Green, N.W.
Harold Deane, B.Sc., 34, Drakefield Road, Upper Tooting, S.W.
Francis Dickinson, 26, O'Connell Avenue, Berkeley Road, Dublin.
Edward Evans, 33, Ranelagh Road, Westminster, S.W.
Thomas Wallace Fagan, B.A., Harper Adams Agricultural College, Newport, Salop.
John Kerr Forrest, Hawsleigh, Balaclava Road, St. Kilda, N.S.W.
Thomas Reginald Hodgson, The Sycamores, Poulton-le-Fylde, Lancs.
George William Thomas Horrod, 294, Brixton Hill, S.W.
John Kenneth Harold Inglis, M.A., B.Sc., University College, W.C.
Thomas Campbell James, B.A., B.Sc., 4, Belmont Terrace, Llanelly.
Walter Richmond James, 49, Wednesfield Road, Wolverhampton.
John Richard Johnson, Apothecaries' Hall, E.C.
Horace Francis Jones, 3, Kerry Crescent, Calne, Wilts.
William App Jones, A.B., A.M., Ph.D., 12E, 18th Street, New York.
Alfred Francis Joseph, A.R.C.S., 95, Marylands Road, Maida Vale, W.
James Stanley Lauder, c/o B. Harvey, Qu'Appelle, N.W.T., Assa., Canada.
Arthur Garfield Levy, B.Sc., A.I.C., c/o B. Blount, Esq., 76, York Street, S.W.
James Patrick Longstaff, B.Sc., 19, Fettes Row, Edinburgh.
Arthur Thomas McDougall, B.A., 3, Albion Road, College Park, S.E.
Harold Joseph Clarke Mathews, Massey's Brewery, Ltd., Burnley, Lancs.

Ernest Westby Millar, A.R.C.S., Windsor, Monkstown, Co. Dublin.
Marie Jean Louis Ernest Rouillard, B.Sc., Malvern, Natal.
Percy Edwin Spielmann, A.R.C.S., 21, Cadogan Gardens, S.W
Harry Stanley, B.Sc., The Park, Southend Village, Catford, S.E.
Thomas Sutcliffe, 19, Rhodes Street, Halifax, Yorks.
Paul John Thibault, Howell, N.S.W.
Douglas Frank Twiss, M.Sc., 89, Wood Lane, Harborne, Birmingham.
Herbert Wood Watson, B.Sc., 111, Brudenell Road, Hyde Park, Leeds.
William Henry Willcox, M.D., B.Sc., F.I.C., St. Mary's Hospital, W.
Frank John Wyeth, M.A., 14, Preston Drove, Brighton.

The PRESIDENT, in announcing the lamented death of Professor Lobry de Bruyn, which occurred in July, after a short illness, reminded the Society that the deceased was one of the Honorary Foreign Members elected recently. A letter of sympathy and condolence had been immediately sent in the name of the Society to the widow, and it was hoped that an obituary notice would shortly appear in the Journal.

Of the following papers, those marked * were read:

***167. "Studies on the dynamic isomerism of α- and β-crotonic acids. Part I." By Robert Selby Morrell and Edward Kenneth Hanson.**

To show the change in the melting point with variation in the composition of a mixture of α- and β-crotonic acids at temperatures below the melting point of the less fusible component (α-crotonic acid), weighed quantities of the α-acid were added to a known weight of the β-acid, and the freezing point of the mixture observed. It was found that the freezing point of the β-crotonic acid fell from 14·96° to a minimum of $-1{\cdot}1°$, and then rose to 43·9° on gradual addition of the α-acid until the mixture contained 30·8 per cent. of the β-acid. To complete the melting point curve, the lowering of the freezing point of α-crotonic acid by the β-isomeride was observed, and it was found that the curve was a continuous one from 15° through $-3°$ (eutectic point) to 71·9°. There is no compound of α- and β-crotonic acids between these temperatures.

The investigation on the composition of the two acids at temperatures between 100° and 168° showed that β-crotonic acid changed on heating into the α-modification, and the composition of the mixture was found by cooling the fused mass rapidly and determining its freezing point. From the observed values of the freezing points for known mixtures of the two acids, the composition of the mixture was fixed without having recourse to estimation by chemical methods. At 168°, the curve showing the transformation of the β-acid into the α-acid met the similar curve for the α-acid changing into the β-acid ; the composition at this point was 76 and 24 per cent. of the α- and β acids respectively. The boiling point under the ordinary pressure of a mixture of α- and β-crotonic acids is 168—174° (compare Michael, *J. pr. Chem.*, 1892, [ii], **46**, 146).

These preliminary experiments furnish no evidence as to the existence of a compound of α- and β-crotonic acids between 100° and 168°.

*168. "The constitution of nitrogen iodide." By Oswald Silberrad.

The empirical formula of nitrogen iodide has been established by Chattaway (*Amer. Chem. J.*, 1900, **23**, 363, 369, and 1901, **24**, 138, 159, 318, 330, 342) as $N_2H_3I_3$, but the analytical results obtained by earlier workers showed great variations, chiefly due to unsuitable methods of preparation, insufficient precautions against the decomposing action of light, and faulty methods of analysis. In view of the methods of preparation and properties of the compound, the formula $N_2H_3I_3$ admits of two possible constitutions: $NH_3\dot{:}NI_3$ and $NHI_2\dot{:}NH_2I$. Chattaway's work does not differentiate between these two formulæ, and the earlier investigations offer no further proof as to the constitution. On the one hand, the liberation of ammonia by the action of acids supports the former configuration, whilst the formation of di-iodomethylamine by the action of methyl iodide appears to render the latter formula probable.

No direct derivatives of nitrogen iodide have so far been prepared in a pure state, the metallic compounds investigated have been incorrectly formulated owing to impurities in the products, and the only organic derivatives of nitrogen iodide hitherto obtained are those prepared by Stahlschmidt (*Poggendorff's Ann.*, 1863, **119**, 421) by the action of methyl iodide. These substances are so indirectly related to nitrogen iodide that they afford no definite proof as to its constitution.

In order to obtain substitution products closely related to nitrogen iodide, the action of zinc ethyl has been studied, and in this way it has been found possible to obtain direct proofs as to the constitution of the iodide.

Zinc ethyl reacts slowly with nitrogen iodide, producing volatile paraffins together with a white, amorphous compound, insoluble in ether, from which ammonia and triethylamine are obtained on treatment with dilute acid and subsequent distillation with aqueous caustic potash. From this it is evident that the constitution of nitrogen iodide is represented by the formula $NH_3{:}NI_3$, and that the action of zinc ethyl proceeds according to the equation :

I. $NH_3{:}NI_3 + 3Zn(C_2H_5)_2 = 3Zn(C_2H_5)I + NH_3 + N(C_2H_5)_3$.
II. $2NH_3 + Zn(C_2H_5)_2 = Zn(NH_2)_2 + 2C_2H_6$.

This formula for the iodide is also supported by many of the observations of earlier investigators.

DISCUSSION.

Dr. CHATTAWAY recalled the fact that in conjunction with Dr. Orton (*Amer. Chem. Journal*, 1901, **24**, 342) he had shown that the formula $H_3N{:}NI_3$ alone could explain the actions which take place when nitrogen iodide is slowly decomposed by a stream of water. In such a progressive decomposition, this molecule is broken up and the ammonia washed away, while NI_3 mixed with iodine remains in the solid residue. If the ratio N : 3I could have been obtained, the formula would have been established beyond question, but, owing to the accumulation of iodine, a possibility of experimental error was introduced, and the ratio 1·18N : 3I was the nearest approach to this on which they felt able to rely confidently ; this ratio, however, excludes all formulæ except the one they put forward. Although he regarded this formula as undoubtedly correct, nevertheless Dr. Silberrad's evidence was not quite conclusive. He drew attention to the small yield of triethylamine, and suggested that under the experimental conditions much of the base would be found in combination with ethyl iodide as tetraethylammonium iodide. It seemed unlikely that nitrogen iodide could be properly dried in quantity by washing with alcohol and afterwards with ether, especially as the compound so very readily interacted with alcohol with the production of ethyl iodide, aldehyde, and ammonia. The triethylamine obtained under these conditions might have been formed by the interaction of ethyl iodide and the liberated ammonia.

He hoped to be able shortly to publish the results obtained by the study of the interaction of nitrogen iodide and the magnesium alkyl compounds, particularly the benzyl derivatives.

Mr. SMART, in replying on behalf of Dr. Silberrad, who was absent, stated that, although ammonia was produced in quantitative yield by the interaction of nitrogen iodide and zinc ethyl, yet the proportion of triethylamine obtained in these experiments was so small that it could not be detected until the experimental conditions had been carefully worked out, and even then large quantities of the iodide had to be treated in order that the base might be isolated and identified. The personal risk involved in treating a kilogram of nitrogen iodide under ether with zinc ethyl was very small in comparison with the danger incurred in dropping the dry iodide into an ethereal solution of zinc ethyl. He believed that a pure metallic derivative of the nitrogen iodide had actually been obtained, and that a paper on this subject would shortly be communicated to the Society.

*169. "The available plant food in soils." By Herbert Ingle.

The results of the author's investigation of the available plant food in soils lead to the following conclusions:

(1) That extraction with a 1 per cent. solution of citric acid for 7 days renders a soil much less fertile, especially at first, but that chemical changes in such soil, during the growth of the plants, gradually render it again capable of supplying plant food.

(2) That beans are able to extract a larger portion of the potash and phosphoric acid present in the soil than barley. This was especially so in the case where extracted soil was used.

(3) That Dyer's method (*Trans.*, 1894, 65, 115) of determining "available" plant food in soils is of considerable value in estimating their relative fertility, but that another factor must be considered, namely, the rate at which the "available" plant food is renewed, especially if the soils exist under different climatic conditions.

Whilst this is probably the same or nearly so for soils under similar climatic conditions, it may be, and probably is, very different in tropical or sub-tropical soils to what it is in those of temperate climates.

DISCUSSION.

Dr. DYER said that he had seen photographs of Mr. Ingle's pot culture experiments, and these certainly seemed to confirm the view that the phosphoric acid and potash soluble in 1 per cent. citric acid solution corresponded with the quantity of those constituents immediately available as plant food. But the most interesting part of Mr. Ingle's work on the subject was that showing the recuperative power of soils even after they had been artificially denuded of immediately available mineral food.

170. "The basic properties of oxygen: compounds of the ethers with nitric acid." By Julius Berend Cohen and John Gatecliff.

In view of recently published results on the additive compounds of the ethers, the following observations which were made early in the year may be of interest. In extracting with ordinary ether the products of the nitric acid oxidation of substituted toluenes, it was frequently observed that, after dehydrating and removing the ether on the water-bath, a small quantity of yellow liquid remained which had a characteristic odour quite unlike that of ether. If this liquid were more strongly heated, or even left for a time, it decomposed with a succession of little explosions and the evolution of nitrous fumes. The liquid is produced by the action of nitric acid on ether and behaves qualitatively like a mixture of these two substances. When added to strong sulphuric acid, nitric oxide is evolved, this result being also obtained by adding strong nitric acid to a mixture of strong sulphuric acid and ether. The liquid behaves like nitric acid to phenol, benzene, and aniline. In order to ascertain whether it had a definite composition the following experiments were made. Definite volumes of the purified ether and dilute nitric acid ($1HNO_3 : 2H_2O$) were shaken up in a separating funnel, the lower layer was removed, and the ethereal layer dehydrated for 24 hours over anhydrous sodium sulphate. The excess of ether was then removed by distillation until the thermometer registered 50°, when the process was stopped, for if the temperature rises above this point decomposition occurs and brown fumes are evolved. Air was now blown into the pale yellow residue contained in a beaker until the odour of ether had almost disappeared. As in this state the liquid decomposes rapidly at the ordinary temperature and slowly even at 0°, quantities of one to two grams were rapidly weighed and made up with water to 100 c.c. A measured volume was then titrated with standard caustic soda, using methyl-orange as indicator. The following results were obtained with purified methylated ether, ethyl ether, and propyl ether.

Ether employed.	Percentage of nitric acid in the product.	Volumes of ether and dilute nitric acid taken.
Methylated ether ...	45·2	50 c.c. HNO_3 : 50 c.c. ether
,, ...	44·4*	50 ,, ,, 50 ,,
,, ...	44·4	25 ,, ,, 50 ,,
Ethyl ether	47·3	50 ,, ,, 50 ,,
,, ...	47·5	50 ,, ,, 50 ,,
Propyl ether	33·8	50 ,, ,, 50 ,,
,, ...	35·9	50 ,, ,, 50 ,,

* The ether in this case was not distilled, but evaporated at the ordinary temperature under 20 mm. pressure.

The calculated amounts of nitric acid corresponding with the formulæ $(C_2H_5)_2O,HNO_3$ and $(C_3H_7)_2O,HNO_3$ are 46 and 38·2 per cent. respectively. The agreement in the case of ethyl ether is quite satisfactory. The compound with propyl ether is evidently less stable at the ordinary temperature, the affinity for nitric acid appearing to diminish with increasing molecular weight. Amyl ether and dilute nitric acid have no interaction at the ordinary temperature, and this is also the case with dimethylquinol, the only aromatic ether investigated.

171. "The condensation of formaldehyde with acetone. A preliminary note." By Emil Alphonse Werner.

When acetone is mixed with a 40 per cent. solution of formaldehyde, no interaction takes place until a small amount of alkali is added; if the liquids are mixed in the undiluted form, the addition of a small amount of caustic potash causes after a few moments a very violent reaction, the liquid boils, and an orange-red, resinous condensation product separates.

When the substances are mixed in 10 per cent. aqueous solution, the reaction proceeds much more slowly, the liquid gradually assumes a dark yellow colour, showing a green fluorescence; after one hour, the condensation product commences to separate as a bright orange-yellow powder, and at the end of 24 hours the reaction is complete. During the change, the alkalinity of the liquid diminishes considerably. The condensation product, when thoroughly washed and dried, forms an orange-yellow, amorphous, satiny powder with a peculiar odour. It has the empirical formula C_4H_5O: analysis gave $C = 68{\cdot}97$ and $69{\cdot}58$, $H = 7{\cdot}46$ and $7{\cdot}54$ per cent., whilst the calculated percentages are $C = 69{\cdot}56$, $H = 7{\cdot}24$. The compound is freely soluble in alcohol, acetone, or glacial acetic acid, and is precipitated unchanged by water; it dissolves sparingly in benzene, chloroform, or ether. The same substance is produced whether the acetone or the formaldehyde be used in excess.

It might have been expected that a compound having the composition C_4H_6O, that is, a polymeride of $CH{:}CH{\cdot}CO{\cdot}CH_3$ ($C = 68{\cdot}56$, $H = 8{\cdot}56$), would have been formed; this, however, does not appear to be the case. With bromine in glacial acetic acid solution, it behaves as a saturated compound, hydrogen bromide is evolved, and a mono-brominated derivative formed, which separates on diluting with water as a dark brown powder.

The addition of hydrochloric acid to the alkaline filtrate from the original experiment produces a yellow precipitate having the same composition as the orange-yellow condensation product.

172. "The union of hydrogen and chlorine. Rate of decay of the activity of gaseous chlorine." By Joseph William Mellor.

The rate at which active chlorine returns to the ordinary condition follows the exponential law $x = x_0 e^{-at}$, where x denotes activity at time

t, and a and x_0 are constants (a being 2·2 approximately). This is true when the activity is induced either by the electric discharge or by exposure to light.

173. "Note on the influence of certain salts and organic substances on the oxidation of guaiacum." By Miss Edith Gertrude Willcock.

The author has investigated the influence of various salts on the oxidation of guaiacum with hydrogen peroxide by determining the time necessary to produce a standard blue tint when the conditions were so adjusted that the concentration of guaiacum, peroxide, and salt, and the temperature were the same throughout the series.

It was found that the oxidation was accelerated by the chlorides of ammonium, lithium, potassium, barium, iron, and aluminium, the bromides of sodium and potassium, potassium iodide, sodium fluoride, and potassium nitrite; whereas the nitrates of ammonium, potassium, and barium, and the sulphates of sodium, potassium, and magnesium had no appreciable influence.

These results show (1) that the influence of the salt is determined by the nature of the anion, and (2) that the halogen salts as a group accelerate the oxidation.

Of the salts examined, those of the halogens alone showed a true accelerating action, for although potassium nitrite certainly accelerates the oxidation of guaiacum by hydrogen peroxide, yet as it will itself oxidise this resin in the absence of the peroxide its influence is not comparable with that of the salts which have no independent oxidising action; this remark also applies to ferric chloride.

A comparison of the salts of the halogens among themselves showed that the iodides have the greatest accelerating action, the effect of the others diminishing in the following order; namely, bromides, chlorides, and fluorides. The position of the iodides in the list may be connected with the oxidising action of hydrogen peroxide on these salts.

Salts such as aluminium chloride and sodium fluoride, which form acid solutions, have a relatively feeble accelerating power.

Ordinary "pure" aluminium chloride readily oxidises guaiacum even in the absence of peroxide, but a specially purified sample of the salt had no independent oxidising action whatever, and it increased the rate of oxidation by hydrogen peroxide only very slightly. The activity of commercial aluminium chloride is probably due to the presence of ferric chloride.

The acids of the acetic series have no accelerating action, but the metallic salts of the lower members of the series have a slight influence, due probably to the fact that they are hydrolysed by water into free acid and base. Carbohydrates and proteids have no action.

Formaldehyde is commonly described as oxidising guaiacum, but this effect is probably due to impurities. The commercial product is an active oxidiser, turning guaiacum blue even in the absence of hydrogen peroxide, but pure formaldehyde, freshly prepared by the distillation of paraformaldehyde, has no action whatever.

Commercial glycerol readily oxidises guaiacum, turning the resin blue immediately, but in this case also the action seems to be due to impurities, for when freshly distilled under diminished pressure in the dark it has no effect by itself, although, like methyl and ethyl alcohols and ethylene glycol, it assists the accelerating action of the metallic haloids at the ordinary temperature (15—25°). These substances, however, at 50—70° all exert a retarding influence, and this may be due to some absorption of the available oxygen by the alcohol.

The carbohydrates dextrose, lævulose, sucrose, maltose, dextrin, starch, glycogen, and mastic decrease the accelerating action of the salts, and the proteid globulin has the same action.

The action of carbohydrates and proteids (globulins) in diminishing the accelerating power of salts is probably due to the fact that the organic substance, being itself oxidisable, absorbs a part of the oxygen which is liberated, and also to its influence on the degree of dissociation of the salt (compare Walker and Hambly, *Trans.*, 1897, **71**, 61).

The effect of sucrose on the electrical conductivity of sodium chloride has been measured by Mr. Hardy, who found that the presence of 16 per cent. of this sugar in a normal solution of the salt diminished the electrical conductivity by 23 per cent. (compare *J. Physiol.*, 1903, **29**, 26).

The accelerating action of the alcohols is adequately explained by their influence on the solubility of the guaiacum. When an alcoholic solution of the resin is added to water, precipitation occurs, but on the addition of more of the alcohol the precipitate redissolves. This was found to be the case with all the alcohols examined except mannitol, and this substance alone failed to accelerate the oxidation of the guaiacum.

174. "Note on the influence of potassium persulphate on the estimation of hydrogen peroxide." By John Albert Newton Friend.

It was shown in a recent communication (*Trans.*, 1904, **85**, 597 that in ordinary circumstances a correct estimate of hydrogen peroxide is not obtained by titration with potassium permanganate. The author now shows that for every molecule of peroxide not accounted for a molecule of persulphate disappears. This observation suggests that the reaction $H_2O_2 + K_2S_2O_8 = K_2SO_4 + H_2SO_4 + O_2$ probably takes place, this change being catalytically accelerated by some oxide of manganese formed during titration.

175. "The influence of sunlight on the dissolution of gold in aqueous potassium cyanide." By William Arthur Caldecott.

The fact that the formation of potassium thiocyanate in aqueous solution, under the conditions indicated by the equation $PbS + KCy + O = PbO + KCNS$, is accelerated by bright sunlight was noted some years ago by Bettel and Feldtmann (*Proc. Chem. Metallurg. Soc. S. Africa*, 1896, 1, 267). In a paper published last year (*J. Chem. Metallurg. Soc. S. Africa*, 1903, 4, 51) by E. H. Johnson and the author, the analogy between potassium aurocyanide and potassium thiocyanate with regard to their formation and reduction was discussed.

The following experiments were carried out with the view of ascertaining whether sunlight accelerated the formation of potassium aurocyanide, as well as that of potassium thiocyanate.

A strip of gold foil weighing 832·5 milligrams and having a total superficial area of 852 sq. mm. was immersed in a 0·5 per cent. potassium cyanide solution, contained in a clear glass litre bottle at about 19°. In another similar glass vessel, coated with three layers of black varnish, was placed a corresponding amount of the potassium cyanide solution and a strip of gold foil weighing 900 milligrams, but with a superficial area equal to that of the other strip. The two bottles were then exposed to direct sunlight for about 5½ hours daily during five days, the loss of weight of the gold foil strips was noted, the maximum temperatures of the solutions being recorded daily. The results were as follows:

	The clear bottle.		The blackened bottle.	
	Gold dissolved in milligrams.	Temp.	Gold dissolved in milligrams.	Temp.
1st day	25·5	36°	20·0	40°
2nd day	21·0	34	17·0	38
3rd day	28·0	34	20·0	38
4th day	27·0	37	17·0	40
5th day	32·0	39	19·0	43
Daily average	26·7	36	18·6	39·8

This table shows that the rate of dissolution of the gold in the clear glass bottle was 43 per cent. greater than that in the blackened vessel, although the temperature of the solution was on an average 3·8° lower than in the former case.

The lately published researches of Berthelot (*Compt. rend.*, 1904, 139, 169) indicate that the absorption of oxygen by aqueous potassium cyanide is accelerated by sunlight. The greater rapidity with which gold dissolves in potassium cyanide solution in bright sunlight may hence be considered as being due to the liberation of more nascent cyanogen, in proportion to the additional oxygen absorbed, with the consequent increased formation of aurous cyanide.

176. "The fractional hydrolysis of amygdalinic acid. *iso*Amygdalin." By Henry Drysdale Dakin.

As amygdalinic acid, prepared by the action of hot baryta solution on amygdalin, gives racemic mandelic acid on complete hydrolysis with acids, it is therefore probably a partially racemic substance, and may be considered as being the maltoside of inactive mandelic acid. On fractional hydrolysis, it was found that the mandelic acid set free in the earlier stages of the reaction was strongly dextrorotatory, whilst that liberated at a later stage was lævorotatory. By repeated crystallisation of the magnesium salts and of the free acids derived from the products of hydrolysis, it was found possible to isolate both optically active varieties of mandelic acid in a pure state.

Starting from amygdalin, which on hydrolysis gives *l*-mandelic acid almost exclusively, it is thus possible to prepare both *d*- and *l*-mandelic acids without employing any additional optically active substance.

The production of an isomeric partially racemic amygdalin, as the result of the limited action of baryta solution on amygdalin, was suggested by J. W. Walker (*Trans.*, 1903, 83, 472), but efforts to isolate the substance were unsuccessful.

The substance has now been obtained in crystalline form, and its main properties have been investigated; it is very much more soluble in water and alcohol, has a much lower melting point and a higher specific rotation than ordinary amygdalin. The close relationship between the two substances is shown by the fact that both are similarly attacked by the enzymes, emulsin and maltase.

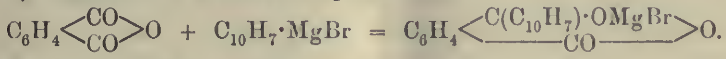
The new substance gives amygdalinic acid and ammonia on treatment with alkali, whilst with concentrated acids it yields mandelic acid, glucose, and ammonia. The mandelic acid set free on complete hydrolysis with hydrochloric acid is distinctly dextrorotatory, whereas that derived from ordinary amygdalin is lævorotatory. The suggested cause of this surprising result is that the two forms of which *iso*-

amygdalin, as a partially racemic substance, may be assumed to be composed are hydrolysed at unequal rates, and that the form which is least readily hydrolysed undergoes progressive racemisation.

177. "The effect of anhydrides on organo-magnesium bromides. Part I. The action of phthalic anhydride on magnesium α-naphthyl bromide." By Samuel Shrowder Pickles and Charles Weizmann.

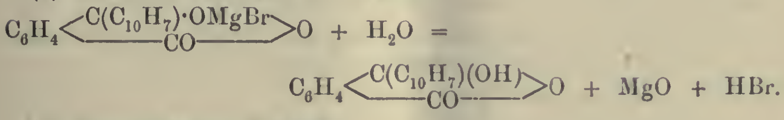
Although Grignard's reaction has been extensively used for the production of hydrocarbons, alcohols, and acids from ketones and esters, the effect of this reaction on anhydrides does not seem to have been studied. With the object of discovering another method for the preparation of certain quinones and their derivatives, the magnesium reaction was tried with magnesium α-naphthyl bromide and phthalic anhydride. The course of the reaction may be expressed as follows:

(1) Formation of additive compound:



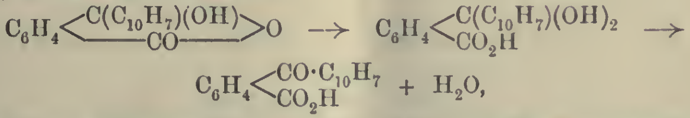
$$\mathrm{C_6H_4}<\begin{matrix}\mathrm{CO}\\\mathrm{CO}\end{matrix}>\mathrm{O} + \mathrm{C_{10}H_7\cdot MgBr} = \mathrm{C_6H_4}<\begin{matrix}\mathrm{C(C_{10}H_7)\cdot OMgBr}\\\mathrm{CO}\end{matrix}>\mathrm{O}.$$

(2) Action of water and dilute acid:



$$\mathrm{C_6H_4}<\begin{matrix}\mathrm{C(C_{10}H_7)\cdot OMgBr}\\\mathrm{CO}\end{matrix}>\mathrm{O} + \mathrm{H_2O} = \mathrm{C_6H_4}<\begin{matrix}\mathrm{C(C_{10}H_7)(OH)}\\\mathrm{CO}\end{matrix}>\mathrm{O} + \mathrm{MgO} + \mathrm{HBr}.$$

(3) Further action of water:



$$\mathrm{C_6H_4}<\begin{matrix}\mathrm{C(C_{10}H_7)(OH)}\\\mathrm{CO}\end{matrix}>\mathrm{O} \longrightarrow \mathrm{C_6H_4}<\begin{matrix}\mathrm{C(C_{10}H_7)(OH)_2}\\\mathrm{CO_2H}\end{matrix} \longrightarrow \mathrm{C_6H_4}<\begin{matrix}\mathrm{CO\cdot C_{10}H_7}\\\mathrm{CO_2H}\end{matrix} + \mathrm{H_2O},$$

the product of the reaction being a keto-acid, in this case, α-naphthoyl-*o*-benzoic acid.

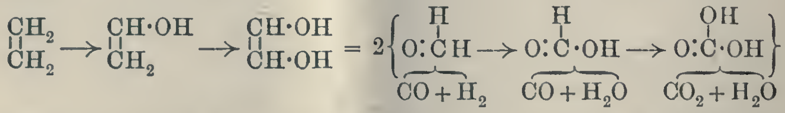
Such acids, on treatment with strong sulphuric acid, pass almost at once into quinones, the foregoing acid, for example, yielding naphthanthraquinone.

Subsequent experiments have shown that the above reaction is capable of general application. Thus, using phthalic anhydride and bromobenzene, the authors have obtained benzoyl-*o*-benzoic acid and anthraquinone, and with phthalic anhydride and β-bromonaphthalene they have obtained β-naphthoyl-*o*-benzoic acid and naphthacenequinone.

Experiments are now being carried out in the aliphatic series with succinic anhydride and various fatty bromides.

178. "The combustion of ethylene." By William Arthur Bone and Richard Vernon Wheeler.

The combustion of ethylene appears to be essentially a process of hydroxylation, that is, oxygen initially enters the hydrocarbon and is distributed between the carbon and hydrogen, giving rise to hydroxylated molecules, which sooner or later, according to the rapidity of the process, undergo thermal decompositions into simpler products. The stages in the combustion are represented by the following scheme:



$$\begin{matrix}CH_2\\ \|\\ CH_2\end{matrix} \longrightarrow \begin{matrix}CH\cdot OH\\ \|\\ CH_2\end{matrix} \longrightarrow \begin{matrix}CH\cdot OH\\ \|\\ CH\cdot OH\end{matrix} = 2\left\{\underbrace{O\colon\overset{H}{\overset{|}{C}}H}_{CO+H_2} \longrightarrow \underbrace{O\colon\overset{H}{\overset{|}{C}}\cdot OH}_{CO+H_2O} \longrightarrow \underbrace{O\colon\overset{OH}{\overset{|}{C}}\cdot OH}_{CO_2+H_2O}\right\}$$

The more salient features of the experiments may be summarised as follows:

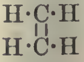
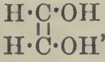
(1) There is no preferential combustion of either carbon or hydrogen when ethylene interacts with a quantity of oxygen insufficient to burn it completely to steam and oxides of carbon. The separation of carbon or hydrogen, when it does occur, is to be entirely ascribed to secondary thermal decompositions.

(2) Formaldehyde is the most prominent intermediate oxidation product, and at low temperatures its formation is probably preceded by that of a less oxygenated product.

(3) The formation of aldehydes precedes that of steam and oxides of carbon.

(4) The stage in the combustion process at which secondary decompositions set in is determined entirely by the temperature conditions. Below the ignition point, such changes do not come into play to any appreciable extent until the stage corresponding with the formation of formic acid is reached. The greater part of this substance then decomposes into carbon monoxide and steam, whilst the remainder is further oxidised to carbonic acid, which in turn breaks down into carbon dioxide and steam. Above the ignition point, the formaldehyde produced rapidly decomposes into carbon monoxide and hydrogen.

(5) There is no separation of carbon or liberation of acetylene, even in the explosive combustion of ethylene, except when the oxygen present is insufficient to burn the hydrocarbon to formaldehyde. In such circumstances, the excess of ethylene is thermally decomposed, yielding carbon, hydrogen, methane, and traces of acetylene. Some evidence was obtained under suitable conditions of the transformation of the initial product, $CH_2\colon CH\cdot OH$, into the isomeric acetaldehyde, which is then independently oxidised to carbon monoxide, water, and formaldehyde, as proved in a previous paper.

The authors have not yet decided whether at low temperatures the oxygen is conveyed to the hydrocarbon directly or indirectly, but at high temperatures, as, for example, in the explosion wave, it is believed that there is a direct passage from  $\begin{matrix}H\cdot C\cdot H\\ \| \\ H\cdot C\cdot H\end{matrix}$ to  $\begin{matrix}H\cdot C\cdot OH\\ \| \\ H\cdot C\cdot OH\end{matrix}$, as the result of collisions between single molecules of ethylene and oxygen.

179. "The decomposition of methylcarbamide." By Charles Edward Fawsitt.

This investigation has been conducted on similar lines to that on carbamide (*Zeit. physikal. Chem.*, 1902, **41**, 601), and it is found that the mechanism of the decomposition is precisely similar in the two cases, so that the theory put forward to explain the decomposition of carbamide is also applicable in the present instance.

The decomposition of methylcarbamide by acids is due to a transformation of the methylcarbamide into methylamine cyanate, which is subsequently decomposed by the acid. The initial transformation is a reaction of the first order, and the velocity coefficient at 99° is almost exactly one-half that of carbamide. In these experiments it is only the free methylcarbamide which represents the active concentration of substance decomposing at any instant. A direct hydrolysis is brought about only very slightly even by very concentrated alkali, and the reaction with pure water is very much slower than is the case with carbamide.

180. "Position isomerism and optical activity; the methyl and ethyl esters of di-*o*-, -*m*-, and -*p*-nitrobenzoyltartaric acids." By Percy Faraday Frankland and John Harger.

The authors describe the preparation and properties of the six esters in question, which were obtained by the action of the three isomeric nitrobenzoyl chlorides on methyl and ethyl tartrates respectively. The rotation of each was determined in the fused state, and over a wide range of temperature, in some cases from 15° to 180°. All these compounds, like the corresponding dibenzoyl- and ditoluyl-tartrates, are strongly lævorotatory. The *p*- and *m*-nitrobenzoyl groups were found to exercise a very great rotatory effect, the molecular rotations of the diethyl di-*p*- and di-*m*-nitrobenzoyltartrates and of the dimethyl di-*p*-nitrobenzoyltartrate being considerably in excess of those exhibited by the corresponding dibenzoyl- and ditoluyl-tartrates. The dimethyl di-*m*-nitrobenzoyltartrate, on the other hand, exhibited a molecular rotation which, although considerably greater than that of dimethyl dibenzoyltartrate, was almost identical with that of dimethyl di-*m*-toluyltartrate.

The *o*-nitrobenzoyl group behaved in an altogether exceptional manner, its relative rotatory influence being entirely dependent on the temperature. Thus it has been previously shown by one of the authors (P. Frankland and Wharton, *Trans.*, 1896, 69, 1591) that the rotatory effect of the *o*-toluyl group is inferior to that of the benzoyl group, and it would have been anticipated, therefore, that the *o*-nitrobenzoyl radicle should exert a still smaller effect; this was actually found to be the case above 130°, but with fall of temperature its rotatory effect so rapidly increases that at 15° the latter proved to be even greater than that of the *p*-nitrobenzoyl group. This abnormal behaviour of the *o*-nitrobenzoyl group, which was only fully studied in the case of the ethyl compound, was thus limited to the superfused state, the melting point of diethyl di-*o*-nitrobenzoyltartrate being 143°. This melting point, again, is exceptional in being considerably higher than that of the meta- (95·8°) and that of the para- (124·5°) compounds respectively.

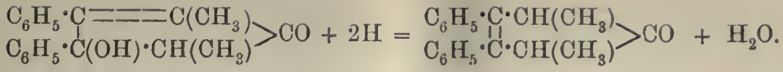
The rotation of all these compounds is very sensitive to temperature, diminishing in every case as the latter rises, much the largest temperature-coefficient being possessed by the ortho-compound.

181. "The action of nitrogen sulphide on organic substances. Part II." By Francis Ernest Francis and Oliver Charles Minty Davis.

The action of nitrogen sulphide on anisaldehyde gives rise to tri-*p*-methoxycyanidine and anisamidine sulphate, which are isolated by taking advantage of their solubilities in benzene and water respectively. An insoluble derivative of anisamidine, containing sulphur, is also produced which is very stable towards alkalis but yields anisoylanisamidine on treatment with strong acids.

182. "Reduction products $\alpha\beta$-di thylanhydracetonebenzil, and condensation products of benzaldehydes with ketones." By Francis Robert Japp and William Maitland.

When $\alpha\beta$-dimethylanhydracetonebenzil is boiled for a few minutes with fuming hydriodic acid, it is reduced to a *cyclopentenone* derivative (m. p. 122°):



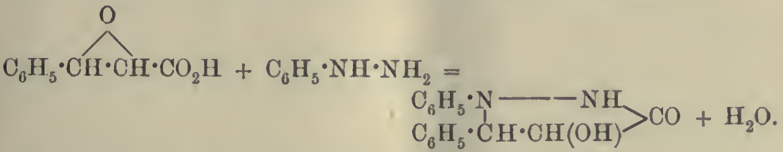
$$\left.\begin{array}{l}C_6H_5\cdot C{=\!=\!=}C(CH_3)\\ C_6H_5\cdot C(OH)\cdot CH(CH_3)\end{array}\right> CO + 2H = \left.\begin{array}{l}C_6H_5\cdot C\cdot CH(CH_3)\\ C_6H_5\cdot C\cdot CH(CH_3)\end{array}\right> CO + H_2O.$$

This compound is identical with that which Vorländer and Wilcke (*Ber.*, 1898, **31**, 1887) obtained by the action of hydrogen chloride on dimethyldiphenyltetrahydro-γ-pyrone, but which they erroneously regard as dibenzylidenediethylketone. By further reduction with hydriodic acid, it yields the corresponding *cyclopentanone* derivative.

The authors have prepared various alkyl derivatives of tetrahydro-γ-pyrone by the usual method of condensing benzaldehyde with aliphatic ketones, and have studied their reactions, especially with the view of obtaining *cyclo*pentenone derivatives.

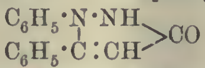
183. "Interaction of sodium phenylglycidate with phenylhydrazine." By Francis Robert Japp and William Maitland.

When sodium phenylglycidate is heated with phenylhydrazine in alcoholic solution at 100°, 4-*hydroxy*-1 : 5-*diphenyl*-3-*pyrazolidone* (m. p. 173·5°) is obtained in the form of its sodium salt:



$$C_6H_5\cdot\overbrace{CH\cdot CH}^{O}\cdot CO_2H + C_6H_5\cdot NH\cdot NH_2 = \left.\begin{array}{l}C_6H_5\cdot N{-\!-\!-\!-}NH\\ C_6H_5\cdot CH\cdot CH(OH)\end{array}\right> CO + H_2O.$$

By the action of heat or of dehydrating agents, hydroxydiphenylpyrazolidone is converted into 1 : 5-diphenyl-3-pyrazolone,

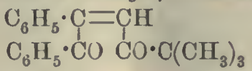


$$\left.\begin{array}{l}C_6H_5\cdot N\cdot NH\\ C_6H_5\cdot C:CH\end{array}\right> CO$$

(m. p. 252°), previously obtained by Knorr (*Ber.*, 1887, **20**, 1107) by distilling cinnamoylphenylhydrazine.

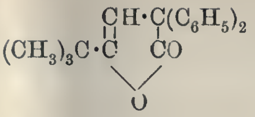
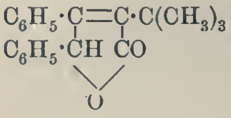
184. "α-Benzoyl-β-trimethacetylstyrene." By Francis Robert Japp and William Maitland.

The authors have obtained *α-benzoyl-β-trimethacetylstyrene*,



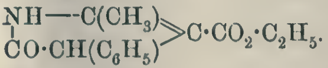
$$\begin{array}{ll}C_6H_5\cdot C & {=\!=}CH\\ C_6H_5\cdot CO & CO\cdot C(CH_3)_3\end{array}$$

(m. p. 115°), by the action of potassium hydroxide on a mixture of benzil and methyl *tert.*-butyl ketone. In its reactions, it closely resembles αβ-dibenzoylstyrene (Japp and Klingemann, *Trans.*, 1890, **57**, 662), except that, on heating, it is converted into a mixture of

two isomeric *crotolactones,*  (m. p. 150°) and  (m. p. 75°).

185. "Olefinic ketonic compounds." By Siegfried Ruhemann.

Rabe (*Ber.*, 1902, **35**, 3947) stated that the additive compound of aniline and ethyl benzylideneacetoacetate melted at 78° instead of at 105° (erroneously printed as 103°) as found by Ruhemann and Watson (*Trans.*, 1904, **85**, 1170). On re-examination, it was found that the melting point could be raised to 106—107°, which closely agreed with that given by Francis (*Ber.*, 1903, **36**, 937) for the substance he obtained by combining benzylideneaniline with ethyl acetoacetate.

The author also examined the action of potassium cyanide on benzylideneacetylacetone and ethyl benzylideneacetoacetate respectively, and found that in the first case cyanobenzylacetylacetone, $C_6H_5\cdot CH(CN)\cdot CH(CO\cdot CH_3)_2$ (m. p. 127—128°), and, in the other, ethyl cyanobenzylacetoacetate, $C_6H_5\cdot CH(CN)\cdot CH(CO\cdot CH_3)\cdot CO_2\cdot C_2H_5$, are produced. On hydrolysis with caustic potash, the former nitrile furnishes phenylacetopropionic acid, $C_6H_5\cdot CH(CO_2H)\cdot CH_2\cdot CO\cdot CH_3$, whilst ethyl cyanobenzylacetoacetate yields a mixture of phenylacetopropionic and phenylsuccinic acids. Under the influence of concentrated sulphuric acid, cyanobenzylacetylacetone is transformed into phenyldiacetopropionic acid, $C_6H_5\cdot CH(CO_2H)CH(CO\cdot CH_3)_2$ (m. p. 149—150°); ethyl cyanobenzylacetoacetate, on the other hand, furnishes the dihydropyrone derivative,  $\begin{matrix}NH—C(CH_3)\\ |\\ CO\cdot CH(C_6H_5)\end{matrix}\!\!>\!C\cdot CO_2\cdot C_2H_5$.

The mode of formation and the properties of cinnamylideneacetylacetone, $C_6H_5\cdot CH{:}CH\cdot CH{:}C(CO\cdot CH_3)_2$ (m. p. 103—104°), are also described. This di-olefinic ketone, on exposure to light, undergoes a change similar to that occurring in the case of cinnamylidenemalonic acid (Liebermann, *Ber.*, 1895, **28**, 1440; Riiber, *Ber.*, 1902, **35**, 2411), and yields a colourless substance (m. p. 158—159°) which has double the molecular weight of cinnamylideneacetylacetone. These two compounds are still under examination.

186. "Δ^{α}-Oleic acid." By Henry Rondel Le Sueur.

In a former communication (*Trans.*, 1904, 85, 827), the author stated that he was engaged in the preparation of an isomeride of oleic acid containing the double linking between the α- and β-carbon atoms, and, although the work is not complete, the appearance of a paper by G. Ponzio (*Gazzetta*, 1904, 34, ii, 77; *Chem. Centr.*, 1904, ii, 691) on the same subject necessitates the publication of the results so far obtained.

Δ^{α}-*Oleic acid*, $C_{15}H_{31}\cdot CH\colon CH\cdot CO_2H$, obtained by the action of alcoholic potash on α bromostearic acid, crystallises from light petroleum in long, flat needles melting at 58—59°; its *ethyl ester* melts at 25—26°. The acid, on oxidation with potassium permanganate, yields $\alpha\beta$-*dihydroxystearic acid* melting at 126°, which on further oxidation yields palmitic acid, thereby proving the position of the double linking.

187. "Action of magnesium alkyl halides on derivatives of camphor." By Martin Onslow Forster.

The action of magnesium alkyl halides on derivatives of camphor is not always normal, and several interesting changes have been observed.

The *compound*, $C_{12}H_{22}O_2$, from camphorquinone and magnesium methiodide is a volatile, colourless compound, dissolving readily in organic media and very sparingly in water, from which it crystallises in minute, transparent prisms and needles melting at 132°. A 2 per cent. solution in absolute alcohol is optically inactive.

The *compound*, $C_{11}H_{19}O_2N$, from *iso*nitrosocamphor and magnesium methiodide is soluble in acids and alkalis, forming colourless solutions; it separates from boiling water as a crystalline powder and melts at 180°.

The *compound*, $C_{11}H_{19}O_3N$, from nitrocamphor and magnesium methiodide is insoluble in sodium carbonate solution, but dissolves in aqueous sodium hydroxide; it crystallises from petroleum in lustrous leaflets melting at 83°.

The *compound* from hydroxymethylenecamphor and magnesium methiodide is a colourless, fragrant oil which boils at 234°/765 mm., has sp. gr. 0·9639, and $[\alpha]_D$ 170·8°. It is insoluble in aqueous sodium hydroxide, and gives no coloration with ethereal ferric chloride.

188. "Sulphonchloroalkylamides." By Frederick Daniel Chattaway.

In the course of an investigation of nitrogen halogen derivatives of the sulphonamides, a number of compounds yielded by various methyl, ethyl, and benzyl derivatives of the sulphonamides have been obtained. All the sulphonalkylamides are readily converted by a solution of hypochlorous acid into the corresponding chloroamides, $RSO_2{\cdot}NHR' + HOCl = RSO_2{\cdot}NClR' + H_2O$. Those containing methyl and ethyl groups are comparatively stable, whereas those in which benzyl occurs undergo spontaneous decomposition after a few hours; even when kept in dry air, chlorine and hydrogen chloride are liberated, while a pungent odour, resembling that of benzaldehyde, becomes apparent. When rapidly heated, they all decompose with evolution of gas, but without explosion. Like the sulphondichloroamides, they are very reactive, and promise to be of considerable value in the synthesis of secondary amines containing different alkyl groups.

The following compounds are typical examples of a long series of these substances which has been prepared. Benzenesulphonchloromethylamide, $C_6H_5{\cdot}SO_2{\cdot}NCl{\cdot}CH_3$, colourless, short rhombs, m. p. 81°; benzenesulphonchloroethylamide, $C_6H_5{\cdot}SO_2{\cdot}NCl{\cdot}C_2H_5$, colourless plates, m. p. 52°; benzenesulphonchlorobenzylamide, $C_6H_5{\cdot}SO_2{\cdot}NCl{\cdot}CH_2{\cdot}C_6H_5$, colourless, slender prisms, m. p. 109°; *p*-toluenesulphonchloromethylamide, $CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl{\cdot}CH_3$, colourless prisms, m. p. 82°; *m*-nitrobenzenesulphonchloromethylamide, $NO_2{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl{\cdot}CH_3$, pale yellow, four-sided plates, m. p. 136°; α-naphthalenesulphonchloromethylamide, $C_{10}H_7{\cdot}SO_2{\cdot}NCl{\cdot}CH_3$, colourless, six-sided prisms, m. p. 78°; α-naphthalenesulphonchlorobenzylamide, $C_{10}H_7{\cdot}SO_2{\cdot}NCl{\cdot}CH_2{\cdot}C_6H_5$, very pale yellow prisms, m. p. 94°; β-naphthalenesulphonchloromethylamide, colourless prisms, m. p. 91°; β-naphthalenesulphonchloropropylamide, $C_{10}H_7{\cdot}SO_2{\cdot}NCl{\cdot}C_3H_7$, colourless plates, m. p. 86°.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 5th, 1904.

At the next ordinary meeting, on **Wednesday**, November 16th, 1904, at 5.30 p.m., the following papers will be communicated :

"The isomerism of the amidines of the naphthalene series." By R. Meldola and J. H. Lane.

"Theory of the production of mercurous nitrite and of its conversion into various mercury nitrates." By P. C. Rây.

"Amidechloroiodides." By G. D. Lander.

"A new synthesis of *iso*caprolactone and some derivatives." By D. T. Jones and G. Tattersall.

"The influence of substitution in the nucleus on the rate of oxidation of the side-chain. Part II. Oxidation of the halogen derivatives of toluene." By J. B. Cohen and J. Miller.

"The halogen derivatives of naphthacenequinone." By S. S. Pickles and C. Weizmann.

"Constitution of pyrazolidone derivatives." By B. Prentice.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

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From the Commission.

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II. *By Purchase.*

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 285.

Wednesday, November 16th, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Professor P. C. Rây was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.

Francis William Frederick Arnaud, A.I.C., 17, Maddox Street, W.
George Douglas Clarkson, Ash House, Mirfield, Yorks.
Samuel George Eade, 10, Eagle Street, Port Talbot, S. Wales.
Carl Richard Hennings, Ph.D., 19, St. Dunstan's Hill, E.C.
Tudor Foulkes Jones, B.Sc., Bro Dawel, Bangor, North Wales.
William Sloan Mills, M.A., Queen's College, Galway.
Harold Schröder, Lithgow, New South Wales.
Ernest Wheeler, 335, Park Road, Oldham, Lancs.
John Henry Becher Wigginton, Kennington Cross, S.E.

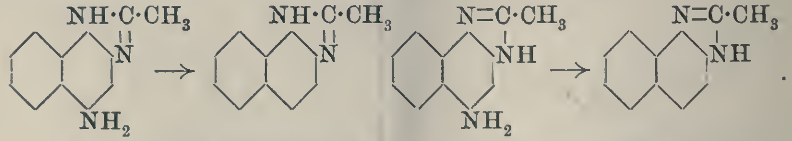
A certificate in favour of the following was authorised by the Council for presentation for ballot under Bye-law I.

Gustav Komppa, Ph.D., Polytechnik, Helsingfors.

Of the following papers, those marked * were read :

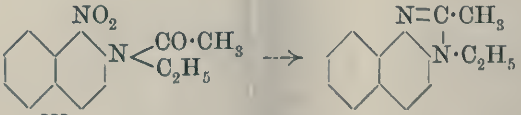
*189. "The isomerism of the amidines of the naphthalene series (fifth communication on anhydro-bases)." By Raphael Meldola and Joseph Henry Lane.

When 2 : 4-dinitroaceto-α-naphthalide is reduced by tin and hydrochloric acid, the aminoamidine (M. and S. ethenyltriaminonaphthalene) has the α-NH constitution (No. I), and the isomeric base (Markfeldt's), produced when iron and hydrochloric acid are used for reduction, has the β-NH constitution (No. II). The constitution of the corresponding ethenyldiaminonaphthalenes follows from this result :

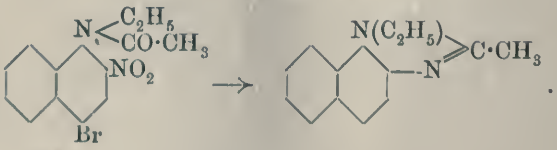


I. New ethenyldiaminonaphthalene (*Trans.*, 1903, **83**, 1190). II. Prager's ethenyldiaminonaphthalene.

This conclusion has been reached by a comparison of the *N*-alkylamidines obtained by the direct alkylation of the ethenyldiaminonaphthalenes with the *N*-alkylamidines prepared synthetically and of known constitution. Thus the *N*-ethylamidine, prepared by the direct ethylation of Prager's base, is identical with the base prepared by reducing the compound No. III, and the isomeric *N*-ethylamidine, obtained by the ethylation of the new ethenyldiaminonaphthalene (*Trans.*, 1903, **83**, 1193), is identical with the base prepared by reducing compound No. IV and then debrominating the product :

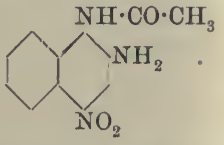


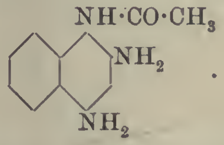
III.



IV.

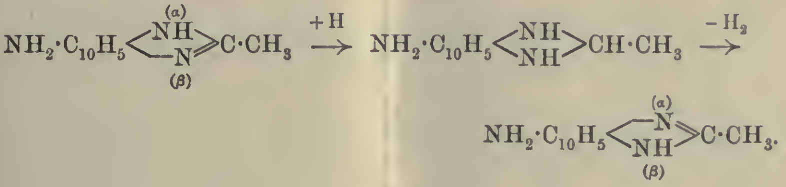
It has thus been shown that the isomerism of the ethenyltriaminonaphthalenes is a case of structural isomerism brought about by a novel and, up to the present time, unique method, namely, the action of different reducing agents on the same dinitro-compound. In explanation of this isomerisation, the hypothesis is advanced that one of the reducing agents, probably the iron, effects a fractional reduction of the nitro-groups, while the other reducing agent attacks both nitro-groups simultaneously. The formation of the amidine ring would thus take place in one case under the orienting influence of the NO_2-group, and in the other case under the orienting influence of the NH_2-group, and the resulting anhydro-bases might under these conditions be expected to be isomeric, the intermediate phases being the compounds:





The investigation is being extended to the benzene series so as to obtain evidence, if possible, of the intermediate phases.

The transformation of the α-NH-aminoamidine into the β-NH-aminoamidine (Trans., 1903, 83, 1200) is explained by the temporary saturation of the amidine ring by hydrogen and the subsequent removal of the element in accordance with the scheme:



$$\mathrm{NH_2\cdot C_{10}H_5}<\begin{matrix}\overset{(\alpha)}{\mathrm{NH}}\\ \underset{(\beta)}{\mathrm{N}}\end{matrix}\gg\mathrm{C\cdot CH_3}\xrightarrow{+\mathrm{H}}\mathrm{NH_2\cdot C_{10}H_5}<\begin{matrix}\mathrm{NH}\\ \mathrm{NH}\end{matrix}>\mathrm{CH\cdot CH_3}\xrightarrow{-\mathrm{H_2}}\mathrm{NH_2\cdot C_{10}H_5}<\begin{matrix}\overset{(\alpha)}{\mathrm{N}}\\ \underset{(\beta)}{\mathrm{NH}}\end{matrix}\gg\mathrm{C\cdot CH_3}.$$

Discussion.

Dr. Lander asked whether Professor Meldola had observed tautomeric relationships between the isomeric amidines. The work might be regarded as settling the nature of the so-called "virtual" tautomerism of the open-chain mixed amidines discovered by von Pechmann.

Dr. Kohn inquired whether the author had tried to reduce the dinitro-compound electrolytically. If not, this method might throw some light on the suggested hypothesis of the formation of the two amidines, since the stages observed in the electrolytic reduction of nitro-compounds were somewhat different from those which obtained with the use of metals and acid.

Dr. Divers asked whether the production of one or other aminoamidine, according to the metal employed, might not rather be due to the reducing action of stannous or ferrous chloride than to that of the metal itself. But even although due to the action of the metal, there may be difference in the effect because the reduction is not caused actually by hydrogen, but by the combined simultaneous action of the metal and the 2 : 4-dinitroaceto-α-naphthalide on the hydrochloric acid.

Dr. MORGAN remarked that the hypothesis that iron and hydrochloric acid reduced the nitro-groups of 2 : 4-dinitroaceto-α-naphthalide successively was supported by the known behaviour of this reducing agent towards *m*-dinitro- compounds in the benzene series. The production of *m*-nitraniline from *m*-dinitrobenzene by the action of limited amounts of iron and acid had formerly been patented (D.R.-P. 67018). He had likewise found that, in the case of dinitromesitylene, the use of iron and water with a small amount of acetic or hydrochloric acid as catalyst led to the production of nitromesidine, whereas complete reduction to diaminomesitylene was effected by employing tin and hydrochloric acid.

Quite recently, Meister, Lucius, & Brüning (D.R.-P. 151768, *Abstr.*, 1904, i, 943) had obtained 1-acetylamino-2 : 4-diaminonaphthalene from 2 : 4-dinitroaceto-α-naphthalide by using iron and acetic acid. As the authors assumed that this acetyltriamine was an intermediate product in the formation of one of the two isomeric aminoamidines, it would be of interest to ascertain whether the acetylated base would yield by direct dehydration the isomeride predicted by their theory.

Professor MELDOLA, in reply, stated that both ferrous and stannous chlorides had been tried as reducing agents. The latter gave rise to the M. and S. base, the former was apparently without action under ordinary conditions. Several metals other than tin and iron had been used as reducing agents, and the results were described in the present and in former papers. Thus far, the action of iron in giving rise directly to Markfeldt's base appeared to be unique.

The practical difficulty that presented itself in all the experiments was the great insolubility of 2:4-dinitroaceto-α-naphthalide. This compound was practically insoluble in cold alcohol and acetic acid. With concentrated sulphuric acid as a solvent, there was a danger of the acetyl group being split off. For this reason, electrolytic reduction had not hitherto been attempted. He agreed with Dr. Lander's view that the results arrived at might be regarded as settling the question of the "virtual" tautomerism of the amidines raised by von Pechmann. There seemed to be no tautomeric relations between the isomeric amidines or aminoamidines. The patented process for preparing acetyltriaminonaphthalene referred to by Dr. Morgan had not yet been tried.

*190. "Theory of the production of mercurous nitrite and of its conversion into various mercury nitrates." By Prafulla Chandra Rây.

Mercurous nitrite is the sole product, other than water, of the immediate action of mercury on dilute nitric acid containing any nitrous acid. In the absence of the latter acid, the former is quite inactive. The formation of the salt may be expressed by the equation $2Hg + NO_2H + HO{\cdot}NO_2 = Hg_2(NO_2)_2 + H_2O$, but it is in part converted by nitric acid into nitrate and nitrous acid. At suitable temperatures and in presence of the right proportions of water and nitric acid, a stage is soon reached in which the quantity of nitrite produced by nitrous acid is just balanced by that decomposed by nitric acid. There then ensues for some time a steady accumulation of mercurous nitrite, during which the production of permanent nitrite is due wholly to the nitric acid, as expressed by the equation $4Hg + 4HNO_3 = Hg_2(NO_2)_2 + Hg_2(NO_3)_2 + 2H_2O$. So long as this equation is valid, there is present in the solution an unvarying quantity of nitrous acid, acting, as it were, catalytically. Analyses of portions of the solution drawn off close to the surface of the mercury give support to the foregoing theoretical considerations. When working at 35°, the mercurous nitrite and mercurous nitrate are present in molecular proportion.

The basic constitution of Marignac's mercurous nitrates is traced to the behaviour of mercuric nitrite, which is itself derived from mercurous nitrite (*Trans.*, 1904, 85, 523). The production of hemi-hydroxy-mercurous nitrate is explained by the following equation: $2Hg_2(NO_3)_2 + 2Hg + Hg_2(NO_2)_2 + 2H_2O = 4HO{\cdot}Hg_2NO_3 + 2NO$.

Two oxy-mercurosic nitrates, one orange-yellow and the other lemon-yellow, the latter best known through Gerhardt's work, the former a salt obtained by the author, are both traced to their origin from mercurous nitrite through the agency of mercuric nitrite. Direct oxidising action, whether by nitric acid or by air, is demonstrated to be at least unnecessary for the production of the mercuric and mercurosic nitrates which result from the prolonged changes occurring in a nitric acid solution of mercury.

*191. "Amidechloroiodides." By George Druce Lander and Harry Edwin Laws.

When pure dry hydrogen iodide is passed into a solution of benzanilide imidechloride in light petroleum, an amidechloroiodide, probably having the constitution $Ph{\cdot}CClI{\cdot}NHPh$, is precipitated as a microcrystalline, yellow powder (m. p. 106° with decomposition). A similar result is obtained with the imidechloride of benzo-*p*-toluidide.

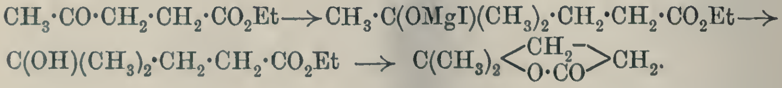
With arylamines and sodium alkyloxides, amidines and imino-ethers respectively are formed, the chloroiodides first losing hydriodic acid and the imidechlorides then reacting in the usual way. As the iodine atom is not capable of giving reactions of substitution no direct evidence in support of the given constitution can be adduced, but the compounds are analogous in physical properties and chemical behaviour to Biltz's amideiodides, $RCI_2{\cdot}NH_2$.

Benzamidedi-iodide, $PhCI_2{\cdot}NH_2$, can be easily prepared by means of dry hydrogen iodide instead of the concentrated aqueous solution used by Biltz. Benzonitrile is formed from it by the action of alcoholic sodium ethoxide.

192. "A new synthesis of *iso*caprolactone and certain derivatives."

By David Trevor Jones and George Tattersall.

*iso*Caprolactone may be easily obtained by the action of magnesium methyl iodide on ethyl lævulate in ethereal solution, the yield being 30 per cent.



$$CH_3{\cdot}CO{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et \longrightarrow CH_3{\cdot}C(OMgI)(CH_3)_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et \longrightarrow$$

$$C(OH)(CH_3)_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et \longrightarrow C(CH_3)_2{<}{\begin{matrix}CH_2-\\O{\cdot}CO\end{matrix}}{>}CH_2.$$

On treating *iso*caprolactone with phosphorus pentabromide in the cold and pouring the product into alcohol, *ethyl γ-bromo*iso*caproate*, $(CH_3)_2CBr{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et$, is formed, which decomposes on distillation.

Ethyl γ-methylallylacetate, $CH_2{:}CMe{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et$, obtained by treating ethyl γ-bromo*iso*caproate with diethylaniline at 140° for 10 minutes, is a fragrant, mobile liquid boiling at 85° under 20 mm. pressure.

γ-Methylallylacetic (γ-methyl-Δ^{γ}-pentenoic) acid,

$$CH_2{:}CMe{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H,$$

produced when the preceding ester is hydrolysed with aqueous caustic soda, is a liquid with a pungent odour; it is volatile in steam and polymerises on distillation.

193. "The influence of substitution in the nucleus on the rate of oxidation of the side-chain. Part II. Oxidation of the halogen derivatives of toluene." By **Julius Berend Cohen** and **James Miller**.

The authors have studied the behaviour of the isomeric chlorobromo- and dibromo-toluenes, and the following table contains a synopsis of the results obtained with these substances and also with the dichlorotoluenes (compare *Trans.*, 1904, **85**, 174), the compounds on the left being least, those on the right most, rapidly oxidised. The bracket indicates an approximately equal rate of oxidation.

<table>
<tr><td>Cl·Cl ......</td><td>3·5</td><td colspan="2">$\underbrace{2{\cdot}5 \qquad 2{\cdot}6}$</td><td>2·3</td><td colspan="2">$\underbrace{2{\cdot}4 \qquad 3{\cdot}4}$</td></tr>
<tr><td>Cl·Br .....</td><td>3·5</td><td>2·5</td><td>2·6</td><td>2·3</td><td>2·4</td><td>3·4</td></tr>
<tr><td>Br·Cl......</td><td></td><td colspan="2">$\underbrace{2{\cdot}5 \qquad\qquad}$</td><td>2·3</td><td>2·4</td><td>3·4</td></tr>
<tr><td>Br·Br......</td><td>3·5</td><td colspan="2">$\underbrace{2{\cdot}3 \qquad 2{\cdot}5}$</td><td>2·6</td><td colspan="2">$\underbrace{2{\cdot}4 \qquad 3{\cdot}4}$</td></tr>
</table>

The order of oxidation is the same in all three series with the exception of the 2 : 3-dibromotoluene, which follows the 3 : 5- instead of the 2 : 5- and 2 : 6-compounds, as in the other two series.

A comparison of the pairs of chlorobromo-compounds with reversed positions of the halogens indicates that the compound, in which bromine occupies the meta-position, is the less rapidly oxidised of the two.

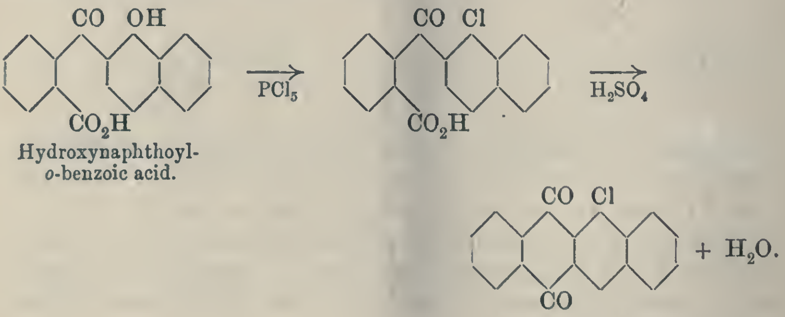
The dibromotoluenes are in all cases less rapidly oxidised than the dichlorotoluenes, and where bromine is in the meta-position the retarding action is much more pronounced than in the other cases.

The position occupied by the chlorobromotoluenes as regards the rate of oxidation is not always midway between the other two series (the dichloro- and dibromo-toluenes), but appears at first sight to be quite irregular; it may be accounted for by the fact that the three monobromotoluenes are much more rapidly oxidised than the three monochlorotoluenes, and if, as appears probable, two different halogens interfere less with each other's individual influence than two similar halogens, the apparent irregularities vanish. The problem is, however, thereby rendered more complex.

The authors propose to introduce the word "*isotopic*" (ἴσος, equal; τόπος, place) to indicate similar compounds substituted in the same positions. Thus the 2 : 3-dichloro-, 2 : 3-chlorobromo-, 3 : 2-chlorobromo-, and 2 : 3-dibromo-toluenes would be "isotopic" substances.

194. "The halogen derivatives of naphthacenequinone." By Samuel Shrowder Pickles and Charles Weizmann.

In the systematic investigation of the halogen derivatives of naphthacenequinone, $C_{18}H_{10}O_2$, the preparation of these compounds by direct bromination or chlorination is not advisable, inasmuch as the separation and identification of the products would be a matter of considerable difficulty. The authors have succeeded in obtaining a monochloro-derivative, in which the position of the chlorine atom is defined by first treating hydroxynaphthoyl-*o*-benzoic acid with phosphorus pentachloride, thus obtaining a chloronaphthoyl-*o*-benzoic acid. On treating this acid with concentrated sulphuric acid, water is eliminated and chloronaphthacenequinone is produced.



Hydroxynaphthoyl-*o*-benzoic acid.

Chloronaphthacenequinone.

195. "The constitution of pyrazolidone derivatives: β-phenylazo*iso*valeric acid and *s*-β-phenylhydrazidobutyric acid." By Bertram Prentice.

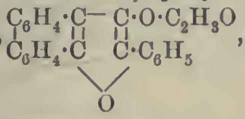
When 1-phenyl-3 : 3-dimethyl-5-pyrazolidone (m. p. 74—75°) is hydrolysed with barium hydroxide, β-phenylazo*iso*valeric acid (m. p. 57—58°) is produced (*Annalen*, 1896, **292**, 272). When treated with reducing agents in acid solution, β-phenylazo*iso*valeric acid yields 1-phenyl-3 : 3-dimethyl-5-pyrazolidone, which is formed by the condensation of the intermediate β-phenylhydrazido*iso*valeric acid.

1-Phenyl-3-methyl-5-pyrazolidone, prepared according to Knorr and Duden's method (*Ber.*, 1893, **26**, 103), was also hydrolysed, and yielded *s*-β-phenylhydrazidobutyric acid, $C_6H_5\cdot NH\cdot NH\cdot CH(CH_3)\cdot CH_2\cdot CO_2H$ (m. p. 96—97°), an unstable substance with strong reducing properties, which on fusion loses 1 molecule of water and becomes converted into 1-phenyl-3-methyl-5-pyrazolidone (m. p. 84—85°).

196. "Preliminary notice of some condensations of phenanthraquinone with ketonic compounds." By Francis Robert Japp and James Wood.

Very few condensations of this class have hitherto been studied, and in these only alkaline condensing agents have been employed; but in many cases such agents give no result. The authors find, however, that acetic anhydride containing a little sulphuric acid frequently brings about the desired reaction.

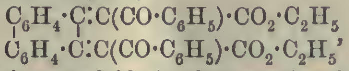
Thus a mixture of phenanthraquinone and acetophenone yields, with this reagent—slowly at the ordinary temperature, more rapidly at 40°—*3-acetoxy-2-phenyl-4:5-diphenylenefurfuran*,



$$\begin{array}{l} C_6H_4\cdot C - C\cdot O\cdot C_2H_3O \\ C_6H_4\cdot C \quad C\cdot C_6H_5 \\ \quad\quad\quad O \end{array}$$

which crystallises from benzene in slender needles (m. p. 232°).

With phenanthraquinone and ethyl benzoylacetate, on the other hand, *ethyl diphenylenedibenzoylmuconate* (*ethyl βγ-diphenylene-αδ-dibenzoylbutadiene-αδ-dicarboxylate*),



$$\begin{array}{l} C_6H_4\cdot C{:}C(CO\cdot C_6H_5)\cdot CO_2\cdot C_2H_5 \\ C_6H_4\cdot C{:}C(CO\cdot C_6H_5)\cdot CO_2\cdot C_2H_5 \end{array},$$

is obtained, the acetic anhydride in this case furnishing no part of the resultant molecule. This substance crystallises from benzene in rectangular plates with bevelled edges. It softens and almost melts between 170° and 174°, but immediately resolidifies, finally melting sharply at 223°. This phenomenon is due to the transformation of the condensation compound into an isomeride, which crystallises from acetic acid in slender needles melting at 223·5°.

Under the foregoing conditions, phenanthraquinone also yields condensation products with ethyl acetoacetate, ethyl malonate, and analogous compounds.

The authors wish to reserve the study of these various condensations.

197. "The decomposition of ethylene iodide under the influence of the iodide ion." By Arthur Slator.

The following is a summary of the results obtained:

(1) Ethylene iodide in aqueous-alcoholic solution decomposes quantitatively in the presence of potassium iodide, yielding ethylene and iodine.

(2) The velocity of reaction is proportional to the concentration of ethylene iodide and also to that of the iodide ion, showing that the potassium iodide takes some direct (or catalytic) part in the reaction. The temperature quotient for 10° is 2·5.

(3) This reaction is distinct from that between ethylene iodide and sodium thiosulphate, for the two reactions may be superimposed without any great mutual interference.

(4) The rate of liberation of iodine from solutions of methyl iodide, *iso*propyl iodide, and ethyl iodoacetate is accelerated by the addition of potassium iodide.

(5) Ethylene bromoiodide in presence of potassium iodide liberates iodine according to the equation : $C_2H_4IBr + KI = C_2H_4 + I_2 + KBr$.

(6) The reaction velocity is proportional to the concentration of the bromoiodide and also to that of the potassium iodide, and the temperature quotient for 10° is 2·45.

Ethylene iodide is probably not an intermediate product in the reaction. The iodide decomposes about three times as fast as the bromoiodide.

198. "The spectrum generally attributed to 'chlorophyll' and its relation to the spectrum of living green tissues." By Walter Noel Hartley.

The author formerly showed (*Trans.*, 1891, 59, 106) that the alcoholic extract of fresh green leaves and also the alcoholic extract of dried leaves do not give the same absorption spectrum as the material in the living leaf when examined under normal conditions. This difference was believed to be due either to the formation or the occurrence of acid in the extract and in the dried leaves, this acid effecting chemical changes in the colouring matter. The same changes in the spectrum could be brought about in the living leaf in an oxidising atmosphere under the action of intense sunlight, and these are conditions which would lead to the formation of an acid.

Marchlewski and Schunck (*Trans.*, 1900, 77, 1080) cast doubt on the accuracy of the author's observations, and more particularly on the efficiency of the process described for extracting the bluish-green colouring matter, Sorby's "blue chlorophyll," in an unchanged condition from an alcoholic extract of green leaves. The author therefore found it desirable to have the process re-examined by an independent observer, and subsequently he repeated the experiments himself. Further measurements of spectra are recorded which confirm the accuracy of the original observations.

199. "Studies on comparative cryoscopy. Part II. The aromatic acids in phenol solution." By Philip Wilfred Robertson.

As in the case of the fatty acids, an intimate relationship is shown between the association and the velocity of esterification ; those acids which are most difficult to esterify associate the least.

Substitution in the ortho-position with respect to the carboxyl group reduces the "rate" of association. The substituent groups or atoms may be arranged in the following order: OH, CH_3, Cl, Br, NO_2. The lighter groups exert only a slight influence, but there is a marked diminution in the case of the heavier groups.

In the case of acids containing two ortho-substituents, however, there is practically no association, whether the substituent is heavy or light. Compounds of this nature are characterised by the fact that they yield esters only with the greatest difficulty, whereas the velocity of esterification of the ortho-substituted benzoic acids is dependent on the weight of the substituting group or atom.

Substitution of the nitro-group in the meta-position still causes a reduction in the "rate" of association, but a lighter group, like methyl, has no influence in this position.

The hydroxylic and dibasic acids are characterised by their sparing solubility in phenol.

200. "Isomeric change of diacylanilides into acylaminoketones. Transformation of dibenzoylaminobenzophenone into 1-benzoylamino-2:4-dibenzoylbenzene." By Frederick Daniel Chattaway and William Henry Lewis.

It has recently been shown (*Trans.*, 1904, 85, 386, 499) that diacyl derivatives of aromatic amines can undergo an intramolecular rearrangement whereby an acyl group leaves the nitrogen and enters the nucleus in an ortho- or a para-position with respect to this element. The transformation of such diacylamino-derivatives can progress beyond the first stage, so that two groups may enter the ring in positions probably ortho- and para- to the nitrogen. The isolation of 1-amino-2:4-dibenzoylbenzene from the product obtained by heating aniline (1 mol.) with benzoyl chloride (3 mols.) was described.

ERRATUM.

Proc., 1904, p. 199.

Line 1, *after* "permanganate" *insert* "in the presence of potassium persulphate."

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 5th, 1904.

At the next Meeting, on **Thursday**, December 1st, 1904, at **8** p.m., there will be a ballot for the election of Fellows, and the following paper will be communicated :

"The nitrites of the alkali metals and metals of the alkaline earths and their decomposition by heat." By P. C. Rây.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Guttmann, Leo F. Percentage tables for elementary analysis. pp. vii + 43. London 1904. From the Author.

Meldola, Raphael. The chemical synthesis of vital products and the inter-relations between organic compounds. Vol. I. Hydrocarbons, alcohols and phenols, aldehydes, ketones, carbohydrates and glucosides, sulphur and cyanogen compounds, camphor and terpenes, colouring-matters of the flavone group. pp. xvi + 339. London 1904. From the Author.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome I. ii. Métalloïdes. Tome II. ii. Métaux. Paris 1904. From Professor Henri Moissan.

II. *By Purchase.*

Bischoff, C. A. Materialien der Stereochemie in Form von Jahresberichten, 1894—1902. 2 vols. pp. cxxxvi + 1977. Braunschweig 1904.

Donath, Eduard. Der Graphit. Eine chemisch-technische Monographie. pp. 175. ill. Leipzig 1904.

Engler, C., und Weissberg, J. Kritische Studien über die Vorgänge der Autoxydation. pp. xi + 204.

Lafar, Franz. Handbuch der technischen Mykologie. Zweite Auflage. Erste Lieferung. ill. Jena 1904.

Roozeboom, H. W. Bakhuis. Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre. Heft 1. Die Phasenlehre-Systeme aus einer Komponente. Heft 2. i. System aus zwei Komponenten. pp. xiii + 221, xii + 467. ill. Braunschweig 1904.

III. *Pamphlets.*

Dyer, Bernard. The manuring of hops. (From the *Brewing Trade Review*, **17**, 1903.)

Dymond, T. S., and Bull, B. W. On tillage crops. (Essex Field Experiments, No. 2.) Chelmsford 1903.

Grindley, H. S., and Mojonnier, Timothy. Experiments on losses in cooking meat, 1900—1903. (U.S. Dept. of Agric. Office of Experiment Stations, Bulletin No. 141.)

Harding, H. A., and Nicholson, J. F. A swelling of canned peas accompanied by a malodorous decomposition. (New York Agric. Exper. Station, Bulletin No. 249.)

Henderson, G. G. Some developments in chemical theory during the nineteenth century. (From the *Proc. Roy. Phil. Soc. Glasgow*, **35**, 1904.)

Hooper, David. Silajit: an ancient Eastern medicine. (From the *Journal of the Asiatic Society of Bengal*, **72**, 1903.)

Hooper, David. The occurrence of Melanterite in Baluchistan. (From the *Journal of the Asiatic Society of Bengal*, **72**, 1903.)

Jordan, W. H., and Fuller, F. D. Inspection of feeding stuffs. (New York Agric. Exper. Station, Bulletin No. 240.)

Kebler, Syman F. Adulterated drugs and chemicals. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 80.) 1904.

New Zealand, Mines Department. Thirty-seventh annual report of the Colonial Laboratory. By J. S. Maclaurin. pp. 30. Wellington 1904.

Page, Logan Waller, and Cushman, Allerton S. The testing of road materials. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 79).

Patten, A. J., and Hart, E. B. The nature of the principal phosphorus compound in wheat bran. (New York Agric. Exper. Station, Bulletin No. 250.)

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 1st, 1904.

Allen, William Harold Richard,

c/o Straits Trading Co., Butterworth, Penang, S.S.

Assayer to the Straits Trading Company's Penang Smelting Works. Studied Chemistry for four years under Dr. Wm. Norman Bott, then Government Analyst and Science Lecturer, Straits Settlements; part time assisting in his laboratory, since which (*i.e.* for past 7 years) have been in the Straits Trading Company, and am now head of their Penang Laboratories, where have done much Research Work on Tin.

W. Norman Bott.	George T. Holloway.
James W. Epps.	*E. G. Clayton.*
L. C. Deverell.	*F. M. Mercer.*

Bentley, Walter Henry,

18, Oaten Hill, Canterbury.

Science Master, Simon Langton Schools, Canterbury. B.A., Merton College, Oxford. Second Class Honours in Chemistry. Chemistry Master at the Simon Langton Schools since Sept. 1902.

John Watts.	Allan F. Walden.
W. W. Fisher.	*H. L. Bowman.*
J. E. Marsh.	*R. de J. Fleming-Struthers.*

Black, John Wyclif,

20, Mardale Crescent, Edinburgh.

Analytical Chemist. Principal Assistant to the late Dr. A. P. Aitken. Lecturer on Practical Chemistry, Royal Dick Veterinary College, Edinburgh, and Demonstrator in Pract. Agricultural

Chemistry, Edinburgh University. Acting Chemist to the Highland and Agricultural Society of Scotland and the Turriff and Garioch Analytical Association, Aberdeenshire.

George McGowan.	*J. Falconer King.*
Stevenson Macadam.	*J. A. Voelcker.*
Samuel Walker.	*James Hendrick.*
G. H. Gemmell.	*J. Alan Murray.*

Busher, Thomas Story,
Queen's College, Oxford.

Student. Special study of Science generally, and Chemistry in particular, for 5 years. Queen's Prizeman in Theoretical Inorganic Chemistry, 1899. Hastings Exhibitioner in Natural Science, Queen's Coll., Oxford, 1899. Bachelor of Arts, with Honours; 2nd Class, Final School of Natural Science (Chemistry), Oxford, 1903. I wish, by means of the publications of the Society, to keep in touch with modern chemical thought and progress.

W. W. Fisher.	*John Watts.*
Allan F. Walden.	*T. Vipond Barker.*
J. E. Marsh.	*R. de J. Fleming-Struthers.*

Caldecott, Lawrence,
47, Woburn Place, Russell Square, W.C.

Schoolmaster. I am keenly interested in Chemical Science, and wish to keep in touch with modern chemical advances by obtaining use of the publications of the Society. I have been working at Univ. Coll. since January, and propose to take up Research Work at the end of the year.

J. Norman Collie.	A. W. Stewart.
Samuel Smiles.	Oscar J. Cole.

Chas. H. Lockitt.

Caldwell, Robert John,
49, Merritt Road, Crofton Park, S.E.

Demonstrator, Department of Chemistry, Central Technical College, S.W. Bachelor of Science (London). A.C.G.I. Published 3 papers (2 in conjunction with Dr. E. F. Armstrong, Ph.D., F.C.S.) in *Proc. Roy. Soc.*, 1904. Late Chemist to British Explosives Syndicate, Ltd., Glasgow, and Pitsea, Essex.

Henry E. Armstrong.	T. Martin Lowry.
Gerald T. Moody.	E. Frankland Armstrong.
William A. Davis.	William Robertson.

Clark, Peter Skinner,

Cape Town, Cape Colony, South Africa.

Medical profession and Public Health. M.B., Ch.M.; late Assistant Demonstrator in Materia Medica and Pharmacy, University of Glasgow. Reason for desiring election, to assist in promotion of Chemical Science (especially in regard to Public Health) in Cape Colony.

G. G. Henderson.	*Thomas Gray.*
W. Carrick Anderson.	*A. Humboldt Sexton.*
John Ferguson.	*Matthew A. Parker.*

Clarkson-Harold, Frederick,

10, Fee's Terrace, Longford, Ireland.

Analyst to Messrs. J. & J. Lonsdale & Co., Ltd., Longford. Late Student of Cheshire County Council Agric. College and Univ. College, Reading. Co-worker with Dr. W. F. Sutherst in researches on "Available phosphoric acid in manures and its estimation," "The reversion of superphosphate of lime in the soil," "Effect of lime on the insoluble phosphates in soils," &c., &c.

Edric Druce.	*Henry J. S. Sand.*
John Hughes.	*Arthur Slator.*
George Tate.	*R. M. Caven.*

C. W. Walker-Tisdale.

Cooper, Jabez Horace,

13, Victoria Terrace, Exeter.

Science Master, Exeter Grammar School. Scholar in Chemistry at Jesus College, Oxford. First Class Honours in Chemistry, Honour School of Natural Science, Oxford, 1903. Exhibitioner in Chemistry, London Intermediate B.Sc.

W. W. Fisher.	W. H. Lewis.
John Watts.	J. E. Marsh.
P. Elford.	N. V. Sidgwick.

Cornthwaite, Robert,

Agricultural Laboratory, Halifax.

Agricultural Chemist and Analyst. Analyst to the West Riding Farmers' Association. Investigator and Lecturer on Agriculture and Milk Analysis. Formerly Student under Prof. Ingle, late of the Yorkshire College and the West Riding County Council Experimental Farm.

Fredk. J. Lloyd.	John A. Dewhirsst.
Jas. Proude.	Alfred Sibson.

Edgar M. Chapman.

Crabb, William,

The Grammar School, Penistone, Yorks.

Chemistry Master. Associate of, and late "Capper Pass" Metallurgical Scholar at, University College, Bristol. B.Sc. (Lond.), 1st Division, in Chemistry, Physics, and Pure Mathematics. Wish to keep in touch with modern developments of Chemistry, with a view to taking up research work later on.

Sydney Young. Ernest Bowman Ludlam.
Francis E. Francis. *W. A. Shenstone.*
F. Wallis Stoddart.

Cunningham, James Edward,

21, Blenheim Gardens, Willesden Green, N.W.

Analyst. June 1897—Sept. 1898, Assistant to Ed. Riley, Esq., F.I.C., F.C.S., City Road. Sept. 1898—Dec. 1900, Assistant Chemist to the Ebbw Vale Steel and Iron Co. Oct. 1901—June 1904, at the Royal College of Science, obtaining the Associateship in June 1904 (Chemistry).

William A. Tilden. G. T. Morgan.
M. O. Forster. Chapman Jones.
James C. Philip.

Dalton, William Herbert,

85, Hayter Road, Brixton Hill, London, S.W.

Consulting Geologist (late of H.M. Geological Survey (17 years); 40 years' study of chemical principles in application to geological problems; and desirous of use of the Chem. Soc. Library for works not in that of the Geological Society.

David Howard. Boverton Redwood.
John Heron. Bernard Dyer.
Horace T. Brown.

Deane, Harold,

34, Drakefield Road, Upper Tooting, S.W.

Pharmaceutical Chemist. B.Sc. (Lond.). For the past three years Demonstrator of Chemistry in the Pharmaceutical Society's School. Associate of the Institute of Chemistry.

J. Norman Collie. Herbert Jackson.
W. Palmer Wynne. M. Carteighe.
T. E. Wallis.

Dickinson, Francis,

26, O'Connell Avenue, Berkeley Road, Dublin.

Analytical Chemist. Was educated at the Manchester Grammar

School and the Owens College, Manchester. Engaged as assistant for 4 years to J. Carter Bell, Esq., F.I.C., A.R.S.M., Public Analyst for Salford, &c.; and have for over 3 years been Head Assistant to Prof. Chas. R. C. Tichborne, F.I.C., &c. Public Analyst to the County of Longford, &c. Am also Junior Demonstrator at the Pharmaceutical School of Chemistry, Dublin.

Chas. R. C. Tichborne. Frank Scudder.
J. Carter Bell. Robert Pettigrew.
Francis Jones.

Evans, Edward,

33, Ranelagh Road, Westminster, S.W.

Chemist to Chief Engineer of South Metropolitan Gas Co., Old Kent Road, S.E. 7 years' experience with research and working of gas manufacture processes and the recovery of by-products.

J. Tcherniac. *Robert Hellon.*
Otto Hehner. *Oscar Guttmann.*
H. F. Brand. *B. E. R. Newlands.*
W. F. Eichenauer.

Evans, John,

Public Analyst's Laboratory, 67, Surrey Street, Sheffield.

Analytical Chemist. Studied for 2 years at the Pharmaceutical Society's Laboratories under Professor J. Norman Collie (1897—1899), Jacob Bell Scholar, 1897. Two years at King's College, London, under Professor J. M. Thomson. Associate of the Institute of Chemistry (A.I.C). At present and for the last three years assistant to Mr. Alfred H. Allen, of Sheffield.

J. Norman Collie. Herbert Jackson.
Arthur Lapworth. Patrick H. Kirkcaldy.
John M. Thomson. G. E. Scott-Smith.
Arnold R. Tankard.

Fagan, Thomas Wallace,

Harper Adams Agricultural College, Newport, Salop.

Lecturer in Chemistry (Pure and Applied) at the Harper Adams Agricultural College. Graduate of Cambridge University with Honours in Chemistry; in my reading am constantly referred to contributions and articles in the Society's Journal, and am anxious to become a Fellow so that I might have copies of the Society's publications.

R. S. Cahill. Hubert Thompson.
C. E. Womersley. Edric Druce.
A. Peacock.

Forrest, John Kerr,

Hawsleigh, Balaclava Road, St. Kilda, Victoria.

Manufacturing Chemist. Studied Chemistry under the late Dr. Stevenson Macadam in Edinburgh, also under Prof. Hartley and Dr. Muter in London. Have had 14 years' experience in laboratory work as Manufacturing Chemist, and 18 years as Manager of Chemical Works. Qualified as Chemist and Druggist in 1874. President of Victorian Society of Chemical Industry, 1904.

Fred. W. Steel.
Orme Masson.
D. Avery.
A. W. Craig.
Frederic Dunn.

Henzell, Archie Willoughby,

Witton Hall Industrial School, Birmingham.

Schoolmaster [Head]. Adv. Chem. (Bd. of Educ.) Teacher's Certificate. Studied Boro' Polytechnic; Univ. Coll., Liverpool; Leicester Tech. School, and Wyggeston School, Leicester.

F. Mollwo Perkin.
J. Gale.
R. L. Barnes.
Alexander M. Chance.
R. J. Friswell.
Rudolph Messel.
A. E. Beanes.

Hodgson, Thomas Reginald,

The Sycamores, Poulton-le-Fylde, Lancashire.

Student in Chemistry. Student in Chemistry for Part II of the Natural Sciences Tripos at Cambridge University.

Charles T. Heycock.
W. J. Sell.
H. O. Jones.
H. J. H. Fenton.
F. W. Dootson.
A. Hutchinson.
G. D. Liveing.

Horrod, George William Thomas,

294, Brixton Hill, London, S.W.

Chemist. Analytical Chemist to The Associated Portland Cement Manufrs. (1900), Ltd., Central Laboratory, Gravesend, Kent. Qualified Chemist of the Pharmaceutical Society.

E. J. Read.
Frank B. Gatehouse.
Edward Horton.
Frank E. Weston.
H. K. G. Bamber.

Inglis, John Kenneth Harold,

University College, London.

Assistant (Chemical Dept.), M.A., B.Sc. (New Zealand), B.Sc. (Edinb.). (1) Action of Ammonium Salts on Solutions of Amm.

Persulphate, *Proc. R.S.E.*, 1902, in conjunction with Hugh Marshall, D.Sc. (2) A Suggested Theory of the Aluminium Anode, *Phil. Mag.*, 1903, in conjunction with W. W. Taylor, D.Sc. (3) Ozon als Oxydations-mittel (with R. Luther), *Zeit. physikal. Chem.*, 1903. (4) Notes on Ozone, &c., *J. C. S.*, 1903. (5) Bemerkungen zur Elektrochemie der Uebermangansäure, *Zeit. Elektrochem.*, 1903.

William Ramsay.	Edward C. Cyril Baly.
J. Norman Collie.	Samuel Smiles.

N. T. M. Wilsmore.

James, Thomas Campbell,

4, Belmont Terrace, Llanelly.

Demonstrator in Chemistry at Univ. Coll. of Wales, Aberystwyth. B.Sc. University of Wales in Chemistry and Physics. 1st Class Nat. Sci. Tripos, Part I, Cambridge. 2nd Class in Chemistry and Physics Nat. Sci. Tripos, Part II. B.A. of Trinity College, Cambridge.

G. D. Liveing.	F. W. Dootson.
W. J. Sell.	H. O. Jones.
H. J. H. Fenton.	J. J. Sudborough.

James, Walter Richmond,

49, Wednesfield Road, Wolverhampton.

Assayer and Metal Refiner. Student of Metallurgy, University, Birmingham. Formerly Student at Wolverhampton Technical School, taking Honours in Chemistry and Metallurgy.

Thomas Turner.	Frank E. Thompson.
Wm. Whitehouse.	*Alex. Findlay.*

Alex. McKenzie.

Johnson, John Richard,

Apothecaries' Hall, London, E.C.

Pharmaceutist. Pharmaceutical Chemist and Member of Pharmaceutical Society. Late Government Analytical Chemist in Jamaica, British West Indies, 1899—1900. Undergrad. Lond. University Inter. Science; Intermediate Exam. Institute of Chemistry.

W. Palmer Wynne.	Peter MacEwan.
Bernard Dyer.	John Castell-Evans.
R. Meldola.	F. Southerden.

Jones, Horace Francis,

3, Kerry Crescent, Calne, Wilts.

Assistant Master County School, Calne, Wilts. Assistant Science Lecturer, County School, Calne. Science Lecturer (includes Chemistry), Pupil Teachers' Centre, Calne. Assistant Instructor and Lecturer, Wilts. County Council Nature Study Courses.

Frank Dixon. *Lawrence W. Mathieson.*
J. Murray Crofts. *W. R. Bird.*
C. H. Corbett. *Thomas C. Davison.*

Jones, William App,

12, E. 18th Street, New York City.

Chemist. A.B. 1893. A.M. 1897. Wake Forest College, N.C. Ph.D., 1898, Johns Hopkins Univ., Baltimore. Scholar 1896 and 1897 Johns Hopkins Univ., Baltimore. Fellow, 1898, Johns Hopkins Univ., Baltimore. 1898, "Study of cuprous chloride—carbon monoxide." 1903, "Action of ozone, &c., on carbon monoxide."

Ira Remsen. Edward C. Worden.
Benj. L. Murray. *R. C. Woodcock.*
Virgil Coblentz.

Joseph, Alfred Francis,

95, Marylands Road, Maida Vale, W.

Lecturer on Chemistry, Wimbledon College, S.W. For 6 years (1896—1902) teaching assistant and lecturer in Chemistry at the Regent Street Polytechnic. Associate of the Royal College of Science (Lond.) in Chemistry, 1st class (Course 1902—1904). At present, lecturer as above.

William A. Tilden. James C. Philip.
Chapman Jones. G. T. Morgan.
M. O. Forster.

Lauder, James Stanley,

c/o B. Harvey, Qu'Appelle, N.W.T. Assa., Canada.

Analytical Chemist. I have been under Prof. J. R. Watson, M.A., Public Analyst, Andersons College Medical Sch., Dumbarton Rd., for four years as his assistant. Since leaving College, I have been on research with "Acetylene Gas," for which I am taking out a patent.

A. Humboldt Sexton. R. T. Thomson.
R. R. Tatlock. *G. G. Henderson.*
Thomas Gray.

Levy, Arthur Garfield,

c/o Bertram Blount, Esq., 76, York Street, Westminster.

Assistant to Mr. Bertram Blount. Bachelor of Science (London). Associate of the Institute of Chemistry. Certificated Student of the Technical College, Finsbury, Chemical Department.

Bertram Blount. John Castell-Evans.
Herbert Jackson. Lewis Eynon.
R. Meldola. F. Henry Streatfeild.
Patrick H. Kirkcaldy.

Longstaff, James Patrick,

19, Fettes Row, Edinburgh.

Assistant, Chemistry Department, The University, Edinburgh. B.Sc. (Edin.) with "special distinction" in Chemistry. Vans Dunlop Scholar, 1897—1900. Formerly Demonstrator in Heriot-Watt College, Edinburgh. "Ammonium molybdate as a delicate reagent for stannous chloride" (*Chem. News*, 1899, 282).

Alex. Crum Brown.
Leonard Dobbin.
Hugh Marshall.
J. Gibson.
Bertram D. Steele.
Alexander Lauder.

McDougall, Arthur Thomas,

3, Albion Road, College Park, London, S.E.

Senior Science Master, Deptford Pupil Teachers' Centre. B.A. (Lond.), Int. B.Sc. (Lond.). 2 years student in Honours Classes at Carpenter Co.'s Institute, Stratford. 6 years Science Master at Deptford P.T. Centre.

William Ping.
W. A. Rugginz.
Edgar E. Horwill.
Arthur H. Coote.
A. W. Harvey.

Mathews, Harold Joseph Clarke,

Massey's Burnley Brewery, Ltd., Burnley, Lancs.

Brewer and Analytical Chemist. Honours Stage in Inorganic and Organic Chemistry (Sci. and Art Dept.); 1st Class Honours, and 1st Prize Silver Medal and Money Prize in Brewing (City and Guilds of London Institute).

William J. Pope.
Jas. Grant.
F. S. Sinnatt.
Stanley J. Peachey.
L. G. Radcliffe.

Millar, Ernest Westby,

Windsor, Monkstown, Co. Dublin.

Student of Chemistry. For 3 years studied at the Royal College of Science, Dublin, of which he is an Associate, and also at University College, London, for 2 years.

J. Norman Collie.
Samuel Smiles.
Edward C. Cyril Baly.
A. W. Stewart.
Alex. W. Bain.

Phillips, George Frederick,

"Tonbridge," Colworth Road, Leytonstone.

Lecturer in Chemistry to the Ilford Council. Bachelor of Science

(Lond.). Third year student by election at Boro' Road College. "Triarian" Special Merit Certificate for Science.

G. T. Morgan. Thomas L. D. Porter.
H. Burrows. *Chapman Jones.*
M. O. Forster.

Rouillard, Marie Jean Louis Ernest,
Malvern, Natal.

Analyst. B.Sc. (Edin.). Student in Analytical Chemistry under Falconer King and Hunter, Edinburgh; was Analytical Chemist in Mauritius for four years with Planters Chemical Manure Co., Ltd. At present Assistant to Public Analyst, Durban, Natal.

H. H. C. Puntan. J. S. Jamieson.
W. H. Pay. A. Pardy.
E. Nevill.

Spielmann, Percy Edwin, A.R.C.S.,
21, Cadogan Gardens, S.W.

Student. Associate of the Royal College of Science. Student at the University College, Gower Street. Desirous of keeping in touch with the progress of Chemistry.

William A. Tilden. Chapman Jones.
M. O. Forster. G. T. Morgan.
James C. Philip.

Stanley, Harry,
The Park, Southend Village, Catford, S.E.

Mathics. and Chem. Tutor. B.Sc. (London). First in order of merit in Honours, Part II, Brd. of Education Chem. Exam. for year 1903. For last 4 years Student at Merchant Venturers' Tech. Coll., Bristol. Desirous of keeping in touch with present day research.

Bevan Lean. G. P. Darnell-Smith.
J. Wertheimer. A. J. Carrier.
Frank B. Gatehouse.

Sutcliffe, Thomas,
19, Rhodes Street, Halifax, Yorks.

Schoolmaster. 3 years Student at Higher Grade School, Halifax. (Analytical Chemistry); 1 year Student at The Tech. Sch., Halifax, Teacher: W. Ackroyd, F.I.C., F.C.S.; 2 terms Student at the Grammar School, Tideswell (under W. G. Boul, M.A., D.C.L., LL.D., F.C.S.). Teacher of Chemistry at Pellon Bd. Sch., Halifax. Teacher of Chemistry at the Grammar Sch., Elland. Reason: that I may keep in touch with Chemical Research, and thus teach the subject more intelligently.

W. G. Boul. C. E. Womersley.
W. Ackroyd. *A. Peacock.*
R. S. Cahill. *F. W. Richardson.*

Thibault, Paul John,
Howell, N.S.W., Australia.

Metallurgical and Analytical Chemist and Assayer. Have practised for a period of thirteen years as a Metallurgical and Analytical Chemist and Assayer, seven years of which were spent as an assistant and student, and six years as a senior man in charge of various laboratories.

Alexander Orr. Will. A. Dixon.
James Taylor. *J. A. Schofield.*
F. B. Guthrie.

Tonkin, Arnold Bertram,
Durban, Natal.

Assistant in the Government Laboratory, Natal. Studied at Penzance School of Mines, 1896—1899. Appointed Assistant in Natal Govt. Laboratory, May 1st, 1902. Am desirous of becoming a member of the Society, in order that I may benefit by the use of the Society's publications.

E. Nevill. J. S. Jamieson.
W. H. Pay. A. Pardy.
H. H. C. Puntan.

Twiss, Douglas Frank,
89, Wood Lane, Harborne, Birmingham.

Lecturer in Chemistry. 1902, Honours B.Sc. at University of Birmingham (awarded University Scholarship); 1903, M.Sc. Degree at University of B'ham.; 1903—1904, Priestley Research Scholar at University of B'ham. Recently appointed Chemistry Lecturer at Birmingham Municipal Technical School.

Percy F. Frankland. Alex. McKenzie.
T. Slater Price. Alex. Findlay.
W. E. S. Turner.

Watson, Edwin Roy,
1, Fair Street, Cambridge.

Student. B.Sc. London, 1st Class Honours in Chemistry. B.A., Cambridge Nat. Science Tripos, Parts I and II. Late member of

Bathymetrical Survey of Scottish Fresh Water Lochs. S. Ruhemann and E. R. Watson, "Contribution to the knowledge of the β-diketones" (*Trans.*, 85, 456).

S. Ruhemann. R. S. Morrell.
M. M. Pattison Muir. Charles T. Heycock.
F. H. Neville.

Watson, Herbert Wood,
111, Brudenell Road, Hyde Park, Leeds.

Analytical Chemist. Studied from 1893 to 1896 at Yorkshire College, taking degree of B.Sc. in Honours School of Chemistry of Victoria University in 1896. From 1896 to 1903, chief assistant to Messrs. Murphy & Lonsdale, Leeds, Brewers, Chemists, &c., and at present Chemist and Bacteriologist to Messrs. Joseph Hobson & Son, Spruce Beer and British Wine Manufacturers, Dantzic Works, Leeds. First Class Honours in Brewing (City and Guilds Exam.). Associate of Yorkshire College. Member of Institute of Brewing, and of Society of Chemical Industry.

Arthur Smithells. *Thomas Fairley.*
Julius B. Cohen. *Alfd. C. Chapman.*
A. J. Murphy. *John Heron.*
Arthur R. Ling.

Weeks, Henry Bridges,
The Retreat, Infield Park, Barrow-in-Furness.

Chemist and Metallurgist. Fellow of the Institute of Chemistry; Member of Society of Chemical Industry; Member Iron and Steel Institute; Chemist and Metallurgist, Vickers, Sons & Maxim, Ltd. Formerly Chemist and Metallurgist, Govt. of India (Ordnance Dept.).

L. Archbutt. J. C. Aylan.
R. J. Redding. Wesley Lambert.
Ernest A. Lewis.

Willcox, William Henry,
St. Mary's Hospital, Paddington, W.

Lecturer on Pathological Chemistry and Practical Toxicology, St. Mary's Hospital, W. Degrees, &c.: B.Sc. (Lond. Univ.); Fellow of Inst. of Chemistry; M.D., (Lond. Univ.); D.P.H.; London University Gold Medallist and Exhibitioner in Organic Chemistry, Materia Medica and Pharmaceutical Chemistry, and Forensic Medicine. Appointments: Lecturer on Chemistry, Queenwood College, Hants, 1893—1895; "Scientific Analyst to the Home Office"; Lecturer on Chemistry, St. Mary's Hospital, London, 1900—1904; Lecturer on Pathological Chemistry, St. Mary's Hospital (now held). Research

Work: Researches on Bran Fermentation (*Jour. Soc. Chem. Industry*), May, 1893. On a pure cultivation of a bacillus fermenting bran infusion (*J. Soc. Chem. Ind.*, June, 1897). Barium butyrate and the estimation of butyric acid (*Jour. Chem. Soc.*, 1897). Toxicological detection of arsenic and influence of selenium on its tests (*Lancet*, March, 1901). The use of phenylhydrazine in the clinical examination of urine (*Lancet*, 1904).

Thomas Stevenson. Frank Clowes.
Arthur P. Luff. John M. Thomson.
Henry Forster Morley.

Wyeth, Frank John, M.A. Cantab., L.C.P., Int. B.Sc., Lond.
14, Preston Drove, Brighton.

Science Master, Elizabeth College, Guernsey; 1st Class Hons. Natural Science Tripos, Cambridge, 1899; Chem. Research Student, London Univ.; 4 years' experience as Chemistry Master in Public Schools; Official Analyst to the States of Guernsey, 1904.

W. J. Stainer. *F. W. Dootson.*
H. J. H. Fenton. *H. O. Jones.*
John E. Mackenzie. *W. J. Sell.*

The following was recommended by the Council for presentation to ballot under Bye-law I. (3):

Komppa, Gustav,
Polytechnik, Helsingfors.

Professor of Chemistry and Director of the Chemical Laboratories. Author of a large number of original papers dealing especially with the camphor group, and among these may be mentioned the synthesis of both apocamphoric acid and camphoric acid.

W. H. Perkin, jun. *Harold B. Dixon.*
F. Stanley Kipping.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 8/12/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 286.

Thursday, December 1st, 1904. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. A. D. Cowper and E. S. Simpson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

Andrea Angel, M.A., 41, Wellington Square, Oxford.
James H. Campbell, 3, Morrison Terrace, North Road, Bellshill, N.B.
Bernard Collitt, 79, Eastbourne Terrace, Gainsborough.
Herbert Goodier, 16, Hall Royd, Shipley.
George Moss Lloyd, M.A., M.Sc., Queen's Road, Rock Ferry.
Thomas Pennycuick, B.Sc., 6, Lorne Street, Fairfield, Liverpool.
Bert Perrott, Ael-y-Bryn, Penywern Road, Neath, Glam.
William Henry Ratcliffe, B.Sc., 18, Wheeler Street, Maidstone.
Frederick George Richards, 21, Dutton Street, Manchester.
Harold Rudolph Rogers, B.A., 75, South Side, Clapham Common, S.W.

The PRESIDENT drew attention to the stand for the display of certificates of candidates for election which had been placed in the Library, and stated that, as the certificates are now printed in full in the "Proceedings," they would not in future be brought down from the Library on the occasion of the ballot.

A Ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

William Harold Richard Allen.
Walter Henry Bentley, B.A.
John Wyclif Black.
Thomas Story Busher, B.A.
Lawrence Caldecott.
Robert John Caldwell, B.Sc.
Peter Skinner Clark, M.B., Ch.M.
Frederick Clarkson-Harold.
Jabez Horace Cooper, B.A.
William Crabb, B.Sc.
James Edward Cunningham.
William Herbert Dalton.
Harold Deane, B.Sc.
Francis Dickinson.
Edward Evans.
John Evans.
Thomas Wallace Fagan, B.A.
John Kerr Forrest.
Archie Willoughby Henzell.
Thomas Reginald Hodgson.
George William Thomas Horrod.
John Kenneth Harold Inglis, M.A., B.Sc.
Thomas Campbell James, B.A., B.Sc.
Walter Richmond James.
John Richard Johnson.
Horace Francis Jones.
William App Jones, Ph.D., A.M.
Alfred Francis Joseph.
Gustav Komppa, Ph.D.
James Stanley Lander.
Arthur Garfield Levy, B.Sc.
James Patrick Longstaff, B.Sc.
Arthur Thomas McDougall, B.A.
Harold Joseph Clarke Mathews.
Ernest Westby Millar.
George Frederick Phillips, B.Sc.
Marie Jean Louis Ernest Rouillard, B.Sc.
Percy Edwin Spielmann.
Harry Stanley, B.Sc.
Thomas Sutcliffe.
Paul John Thibault.
Arnold Bertram Tonkin.
Douglas Frank Twiss, M.Sc.
Edwin Roy Watson, B.A., B.Sc.
Herbert Wood Watson, B.Sc.
Henry Bridges Weeks.
William Henry Willcox, M.D., B.Sc.
Frank John Wyeth, M.A.

Of the following papers, those marked * were read :

*201. "The nitrites of the alkali metals and metals of the alkaline earths and their decomposition by heat." By Prafulla Chandra Rây.

Solutions of the nitrites of barium and calcium, like those of the alkali metals, can be safely evaporated to dryness at the boiling temperature without decomposition or oxidation taking place.

A solution of magnesium nitrite prepared by the double decomposition between barium nitrite and magnesium sulphate is perfectly stable at the ordinary temperature, but it cannot be concentrated on the water-bath as it undergoes decomposition even at 60°, evolving nitric oxide. The solution, when concentrated under reduced pressure over sulphuric acid, yields the hydrated salt $Mg(NO_2)_2,3H_2O$, which, when kept in a desiccator, loses only one molecule of water, the dehydration not going any further. All the nitrites described have a faint yellow colour. When barium nitrite is heated under reduced pressure at 225—300°, the following reactions occur :

$$3Ba(NO_2)_2 = 2BaO + Ba(NO_3)_2 + 4NO,$$
$$2Ba(NO_2)_2 = BaO + Ba(NO_3)_2 + NO + N\ ;$$

whereas at temperatures between 300° and 500° or upwards the following change takes place:

$$Ba(NO_2)_2 = BaO + 2NO_2 + O_2.$$

The other nitrites behave similarly. In the earlier stages, the gaseous products of decomposition are mainly nitric oxide and nitrogen, in the second they are chiefly nitrogen peroxide and oxygen. It is difficult to distinguish sharply between these two stages, and an intermediate phase has been observed:

$$Ba(NO_3)_2 = Ba(NO_2)_2 + O_2.$$

The decomposition of magnesium nitrite begins at 60°, and at 120° that of the first stage is complete, resulting in the formation of a basic nitrate, $Mg(NO_3)_2,MgO$, which is stable even at 175°.

*202. "The metallic derivatives of nitrogen iodide and their bearing on its constitution." By Oswald Silberrad.

On examining Guyard's copper derivative (compare *Compt. rend.*, 1884, 97, 526), the compound was found to be a *cuprosamine periodide*, $Cu_2I_2(5NH_3)I_4,H_2O$, and not a derivative of nitrogen iodide; it is not explosive, and has the properties of a periodide. On heating, it evolves iodine vapour, and by treating with potassium iodide solution the loosely combined iodine is removed quantitatively. The regeneration of nitrogen iodide from the cuprosamine periodide by ammonia must also be regarded as distinct evidence of its periodide character, for, according to this view, the loosely combined iodine reacts with ammonia precisely as does potassium periodide.

Cuprosamine Iodide, $Cu_2I_2,NH_3,4H_2O$.—When the foregoing periodide is treated with potassium iodide solution, the loosely combined iodine is removed and a green, crystalline residue remains behind, which dries to an olive-green, crystalline powder having the above formula; it is insoluble in water, but dissolves fairly readily in ammonia.

The silver derivative formulated by Szuhay as $AgNI_2$ (*Ber.*, 1893, 26, 1933) was again investigated, but it was found that by following his method a compound of constant composition could not be prepared. By the addition of iodine chloride solution to an ammoniacal silver solution, a pure product having the formula NI_3NH_2Ag was obtained. The substance decomposes readily, even at the ordinary temperature and especially when exposed to light; in the dry state, it explodes on the slightest friction. It dissolves readily in potassium cyanide and is regenerated by the addition of ammoniacal silver nitrate. Szuhay stated that an intermediate potassium salt was formed. This is disproved by an examination of the solution obtained by adding potassium cyanide to nitrogen iodide. Exactly 3 mols. of potassium cyanide were required to dissolve 1 mol. of nitrogen iodide, this number being independent of the excess of ammonia present. The products identified were cyanogen iodide, potassium iodide, potassium carbonate, potassium cyanate, ammonia, and cyanogen. The mechanism of the change is as follows:

1. $3KCN + NH_3NI_3 + 3H_2O = 3CNI + 3KOH + 2NH_3$.
2. $CNI + 2KOH = KCNO + KI + H_2O$.
3. $2KCNO + 3H_2O = K_2CO_3 + 2NH_3 + CO_2$.

At low temperatures and in concentrated solution, the cyanogen iodide is partially precipitated, but at the ordinary temperature it rapidly decomposes in solution.

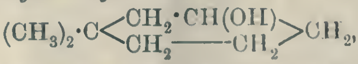
The action of potassium cyanide on the silver derivative took place in accordance with the equation:

$$NI_3{:}NH_2Ag + 4KCN + 4H_2O = 3CNI + AgCN + 4KOH + 2NH_3.$$

It was also found that although cyanogen iodide produced no precipitate of nitrogen iodide when added to ammonia, yet in the presence of silver the compound $NI_3{:}NH_2Ag$ was readily obtained. The behaviour of the silver compound towards potassium cyanide is thus fully explained without any necessity for assuming the existence of an intermediate potassium salt.

*203. "Synthesis of 1:1-dimethylhexahydrobenzene." By Arthur William Crossley and Nora Renouf.

5-Chloro-3-keto-1:1-dimethyl-Δ^4-tetrahydrobenzene (*Trans.*, 1903, **83**, 117), when treated with sodium in moist ethereal solution, yields 3-*hydroxy*-1:1 *dimethylhexahydrobenzene*,



$$(CH_3)_2{\cdot}C{<}\begin{matrix}CH_2{\cdot}CH(OH)\\ CH_2\text{———}CH_2\end{matrix}{>}CH_2,$$

together with other substances not yet investigated. The product is a clear colourless liquid boiling at 99·5°/35 mm. and having a marked odour of peppermint. When treated with fuming hydrobromic acid, it is converted into 3-*bromo*-1:1-*dimethylhexahydrobenzene*, a colourless liquid boiling at 98°/50 mm. The bromine atom in this compound is readily replaced by hydrogen on heating with zinc dust in aqueous alcoholic solution, giving rise to 1:1-*dimethylhexahydrobenzene*, which is a colourless refractive liquid boiling at 117°/743 mm. and having a geranium-like odour.

In 1902, Zelinsky (*Annalen*, 1902, **319**, 318) described the preparation of dihydro*iso*laurolene, which hydrocarbon, he suggested, was 1 : 1-dimethylhexahydrobenzene, and the authors are at present comparing the properties of these two hydrocarbons, and also the properties of 1 : 1-dimethyltetrahydrobenzene, with the hydrocarbons of the formula C_8H_{14}, which have at various times been obtained from derivatives of camphor.

*204. "The formation and reactions of imino-compounds. I. Condensation of ethyl cyanoacetate with its sodium derivative." By Harold Baron, Frederick George Percy Remfry, and Jocelyn Field Thorpe.

Ethyl cyanoacetate condenses with its sodium derivative forming the sodium compound of *ethyl α-cyano-β-iminoglutarate*,

$$CO_2Et{\cdot}CHNa{\cdot}C(\colon NH){\cdot}CH(CN){\cdot}CO_2Et,$$

which can readily be converted into *ethyl α-cyano-β-iminoglutarate*, $CO_2Et{\cdot}\underset{(1)}{C}\underset{(3)}{H_2}{\cdot}C(\colon NH){\cdot}\underset{(2)}{CH}(CN){\cdot}CO_2Et$. This substance contains three hydrogen atoms capable of replacement by sodium in the order indicated by the numerals.

Ethyl α-cyano-β-iminoglutarate and its alkyl derivatives yield the corresponding ethyl hydrogen salts,

$$CO_2H{\cdot}CHR{\cdot}C(\colon NH){\cdot}CR(CN){\cdot}CO_2Et,$$

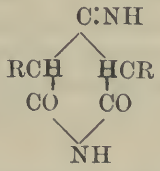
on hydrolysis with sodium carbonate.

These compounds, on heating above their melting points, are converted into derivatives of glutazine, which can be transformed into the corresponding derivatives of 2 : 4 : 6-trioxypyridine by suitable reagents.

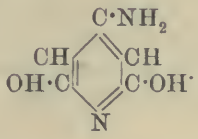
The same glutazine derivatives are formed by the action of concentrated sulphuric acid on the diethyl salts.

The substitution derivatives of glutazine can react in the two forms :

I.



II.

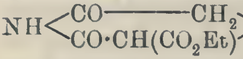
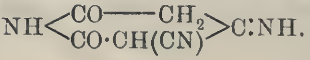


The mono-substitution derivatives react in the second form towards acid hydrolysing agents, and in the first form towards nitrous acid.

The di-substitution derivatives react only in the second form, whilst the tri-substitution derivatives react in the first form.

Ethyl α-cyano-β-iminoglutamate,

$$CONH_2{\cdot}CH_2{\cdot}C(\colon NH){\cdot}CH(CN){\cdot}CO_2Et,$$

can be converted into a derivative of glutazine in two ways. Thus, with concentrated sulphuric acid, it yields *ethyl glutazinecarboxylate*,  $\mathrm{NH}\left<\begin{matrix}\mathrm{CO}\text{———}\mathrm{CH_2}\\ \mathrm{CO\cdot CH(CO_2Et)}\end{matrix}\right>\mathrm{C{:}NH}$, but with sodium carbonate solution it is converted into glutazine cyanide,  $\mathrm{NH}\left<\begin{matrix}\mathrm{CO}\text{——}\mathrm{CH_2}\\ \mathrm{CO\cdot CH(CN)}\end{matrix}\right>\mathrm{C{:}NH}$.

*205. "The affinity constants of aniline and its derivatives." By Robert Crosbie Farmer and Frederick John Warth.

The affinity constants of aniline and its derivatives are best determined through the hydrolytic dissociation of their salts. For this purpose, the method of distribution between two solvents, previously employed by one of the authors (Farmer, *Trans.*, 1901, **79**, 863), has been applied to these compounds. The advantages of the method are, mainly, its applicability to (1) sparingly soluble organic compounds, (2) strongly coloured solutions, (3) solutions in which a slight decomposition interferes with titrations, (4) salts which are hydrolysed to the extent of nearly 100 per cent. in solution.

Comparative experiments showed that the sulphates of aniline and the toluidines were in all instances hydrolysed to a greater extent than the corresponding hydrochlorides, but the relative difference decreased in dilute solution.

o-Nitroaniline showed practically no tendency to form a hydrochloride in aqueous solution, and *p*-nitroaniline was a much weaker base than the meta-isomeride. The nitroanilines exhibited no acidic properties when examined by the same method in presence of caustic potash.

The substituents arranged themselves in the following order as regards their influence on the affinity constant of aniline, the nitro-group being the most electronegative: NO_2, CO_2H, $\cdot N{:}N\cdot C_6H_5$, Br, Cl, CH_3, OCH_3. *a*- and *β*-Naphthylamines were somewhat weaker bases than aniline. Acetanilide and aceto-*o*-toluidide showed practically no basic properties. *p*-Nitrosomethylaniline possessed easily measurable acidic properties in addition to its basic properties, but *p*-nitrosodimethylaniline showed no tendency to form salts with alkalis.

206. "The attractive force of crystals for like molecules in saturated solutions." By Edward Sonstadt.

The author describes the preparation of saturated solutions in pairs r in sets, in which to one or more of the solutions is added a quantity he crystals of the dissolved salt, the flasks or other containing ls being left together in a cellar in which the temperature varies only slowly. The added crystals draw from the solution in which they are deposited a certain portion of the salt, so that the supernatant liquid contains, after a time, an appreciably smaller proportion of the dissolved salt than the solutions contained in the other vessels, to which no crystals had been added. The determinations were made either by evaporating a weighed portion of each of the solutions and weighing the residue, or by taking the density of the solutions by a specific gravity bottle.

207. "The Grignard reaction applied to the esters of hydroxy-acids." By Percy Faraday Frankland and Douglas Frank Twiss.

By acting on dimethyl tartrate with magnesium phenyl bromide and treating the product with dilute sulphuric acid, the authors have obtained a compound crystallising in small, white needles (m. p. 148°), which is presumably *ααδδ*-tetraphenylerythritol,

$$(C_6H_5)_2C(OH)\cdot CH(OH)\cdot CH(OH)\cdot C(OH)(C_6H_5)_2.$$

It is powerfully dextrorotatory, a 4·327 per cent. solution in ethyl alcohol giving $[\alpha]_D^{20^\circ} + 182\cdot 8^\circ$. The compound is isomeric with the already known benzoïnpinacone (tetraphenylerythritol, m. p. 235°), $C_6H_5\cdot CH(OH)\cdot C(OH)(C_6H_5)\cdot C(OH)(C_6H_5)\cdot CH(OH)\cdot C_6H_5$, obtained by Kauffmann (*Chem. Centr.*, 1898, I, 1232) by the electrolytic reduction of benzil or benzoïn, and which is, of course, inactive.

The authors, who are proceeding with the investigation, are making this preliminary communication in consequence of the incidental description by Acree (*Ber.*, 1904, **37**, 2753) of the action of magnesium phenyl bromide on inactive methyl mandelate with production of triphenylglycol.

208. "Note on the addition of hydrogen cyanide to unsaturated compounds." By Arthur Lapworth.

Knoevenagel has recently stated (*Ber.*, 1904, **37**, 4065) that mesityl oxide unites nearly quantitatively with pure hydrogen cyanide, and in proof he cites the yield of mesitylic acid obtained by adding potassium hydroxide to the mixture after eight days and then boiling. As potassium cyanide, in presence of potassium hydroxide, rapidly converts mesityl oxide into mesitylic acid, Knoevenagel's experiment throws no light on the subject.

Experiments at 100° with hydrogen cyanide dissolved in alcohol are apt to be misleading, as after some hours at this temperature the solution is often faintly alkaline, and is much more reactive than before heating. The author has never obtained an appreciable amount of additive product when hydrocyanic acid free from all trace of basic impurity was warmed with an αβ-unsaturated ketone; nevertheless, the views which he has put forward as to the mechanism of such processes are altogether opposed to the assumption that pure hydrogen cyanide is devoid of additive properties in any instance where addition occurs in presence of a base or a metallic cyanide (compare Knoevenagel, *loc. cit.*, p. 4067).

Alkylidenecyanoacetic acids react very readily with hydrogen cyanide in presence of bases or metallic cyanides; the products vary with the precise conditions imposed, but with care it is easy to obtain nearly quantitative yields of compounds derived from the type $CHX(CN)\cdot CH(CN)\cdot CO_2H$, and from which alkylsuccinic acids are produced by acid hydrolysis. For example, phenylsuccinic acid may rapidly be synthesised from benzaldehyde, potassium chloroacetate, and potassium cyanide. The study of this reaction as applied to both fatty and aromatic aldehydes is in progress. Alkylidenemalonic acids do not appear to be capable of uniting with hydrogen cyanide.

WISLICENUS MEMORIAL LECTURE.

The Wislicenus Memorial Lecture will be delivered by Professor W. H. Perkin, F.R.S., on **Wednesday**, January 25th, at **8.30** p.m.

At the next Ordinary Meeting, on **Wednesday**, December **14th**, at **5.30** p.m., the following papers will be communicated:—

"Hydrolysis of ammonium salts." By V. H. Veley.

"The viscosity of liquid mixtures. Part II." By A. E. Dunstan.

"The diazo-reaction in the diphenyl series. Part II. Ethoxybenzidine." By J. C. Cain.

"The sulphate and the phosphate of the dimercurammonium series." By P. C. Rây.

"A method for the direct production of certain aminoazo-compounds." By R. Meldola and L. Eynon.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK

Issued 31/12/04

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 20. No. 287.

Wednesday, December 14th, 1904. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. J. C. Cain and W. H. Willcox were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs :

James Hector Barnes, B.Sc., The Briars, King's Norton, Birmingham.
Bernard Mount Jones, B.A, "Alcala," Hermitage Road, Upper Norwood, S.E.
Herbert Louis Leech, 3, London Road, Blackburn.
Alfred Courtenay Luck, The Naval Arsenal, Zarate, Argentina.
Andrew Norman Meldrum, D.Sc., 16, Mooroaks Road, Sheffield.
Charles Watson Moore, B.Sc., 38, Demesne Road, Whalley Range, Manchester.
Ernest Quant, 2, Park Crescent, Torquay.
Gustav Arthur Troye, P.O. Box 2706, Johannesburg.
William Phillip Want, 11, Pearfield Road, Forest Hill, S.E.
John Wells Wilkinson, M.A., 28, Egerton Terrace, Bexley Road, Belvedere.
Alan Herbert Williams, 127, Roseneath Road, Urmston, near Manchester.

The following Certificate was authorised by Council under Bye-law I (3):

H. Chandra Chatterjee, Cawnpore, India.

Of the following papers, those marked * were read:

*209. "Hydrolysis of ammonium salts." By Victor Herbert Veley.

When aqueous solutions of ammonium salts are heated to their boiling points, the evolution of ammonia and the concomitant acidity of the solutions result not from a direct dissociation, but from hydrolysis. Three cases are presented: (i) the hydrolysis is *nil* or inappreciable, (ii) it is dependent on the dilution, and (iii) it is independent of dilution when beyond a certain limiting value.

The persistence or avidity with which the several acids retain the ammonia in combination is analogous to their activity or avidity in the cases of hydrolysis of methyl acetate and the inversion of cane sugar, the relative, but not the absolute, order of magnitude being the same in all these three chemical changes.

DISCUSSION.

Professor CROSSLEY said that this behaviour of ammonium salts on distillation was capable of being of great service in the separation of organic acids, and instanced the case (*Trans.*, 1898, **73**, 13) where it had been found possible to separate *iso*propylsuccinic acid from a complicated mixture of fatty acids by distilling in steam a solution of the mixed acids in ammonium hydroxide, when ammonium *iso*propylsuccinate was left in the residue.

*210. "The viscosity of liquid mixtures. Part II." By Albert Ernest Dunstan.

The author's conclusions in a previous paper (*Trans.*, 1904, **85**, 817) are confirmed by the present series of results, and by means of a slightly modified apparatus the viscosity-concentration curves for the following mixtures have been investigated.

1. Allyl alcohol and water:—Maximum point at 51—52 per cent. allyl alcohol, corresponding with 1 allyl alcohol, 3 water, and a discontinuity with 40 per cent. allyl alcohol corresponding with 1 allyl alcohol, 5 water.

2. Propyl alcohol and water:—Maximum point at 61—62 per cent. propyl alcohol, corresponding with 1 propyl alcohol, 2 water.

3. Glycol and water:—Sagged curve approximating to the normal. Maximum divergence from the straight line at the point 1 glycol, 2 water.

4. Lactic acid and water:—Sagged curve as for glycol and water. Maximum divergence at the point 1 lactic acid, 2 water.

5. Benzene and acetic acid:—Minimum point at 89 per cent. benzene, corresponding with 5 benzene, 1 acetic acid.

6. Benzene and propyl alcohol:—Minimum point at 95 per cent. benzene, corresponding with 12 benzene, 1 propyl alcohol.

Although it might be expected that such very viscous substances as glycol and lactic acid, which at the same time are associative, would give maximum points in a similar way to other hydroxylated liquids, yet this is not the case, because further association or the formation of higher complexes with water is impossible; a breaking down into simpler groups takes place, although it is quite likely that aggregates are formed as in other cases.

The minima obtained with benzene solutions are regarded as being due to the formation of definite aggregates less complex than those of the original hydroxylated substances.

*211. "The diazo-reaction in the diphenyl series. Part II. Ethoxybenzidine." By John Cannell Cain.

The author has examined the action of heat on the solution of the diazonium salt prepared from ethoxybenzidine and has shown that one diazonium group is normally substituted by hydroxyl whilst the other remains intact. It seems certain from the fact that dianisidine is much more stable than benzidine in this connection that the diazonium group which is adjacent to the ethoxy-group is the one which remains unchanged. The diazonium sulphate has the formula $OH{\cdot}C_6H_4{\cdot}C_6H_3(OEt){\cdot}N(\vdots N){\cdot}HSO_4$, and can be recrystallised from boiling dilute sulphuric acid; it forms long, acicular, brown crystals easily soluble in water. The free diazonium hydroxide is precipitated by sodium carbonate as a lilac mass which dissolves in acids forming the corresponding salts.

4′-Hydroxy-3-ethoxydiphenyl-4-diazonium sulphate and the corresponding chloride, bromide, iodide, nitrate, and platinichloride have been prepared.

*212. "The sulphate and the phosphate of the dimercurammonium series." By Prafulla Chandra Rây.

It has already been shown that when dimercurammonium nitrite, NHg_2NO_2, is treated with a halogen acid the molecular structure of the compound is destroyed, and a double salt of the type $2HgX_2,NH_4X$ is formed, where X represents a halogen atom (*Trans.*, 1902, 81, 644). If, however, an oxy-acid is substituted for the halogen acid, the *dimercurammonium* complex remains intact, and the NO_2-group is simply replaced by the corresponding acid ion. In this way, the author has lately succeeded in preparing the sulphate, $(NHg_2)_2SO_4,H_2O$, and the phosphate, $NHgH_2PO_4$, of the series.

*213. "A method for the direct production of certain aminoazo-compounds." By Raphael Meldola and Lewis Eynon.

The authors have found that most diazotised amines when treated in aqueous solution with a strong solution of sodium dichromate give crystalline precipitates of diazonium chromates which can be isolated and used in the solid condition. It is pointed out that this method is at present the only practical process for isolating diazonium salts with inorganic acid radicles from aqueous solutions. In the case of diamines, a means for the direct production of aminoazo-compounds has thus been found. Diazotised *p*-phenylenediamine gives a chromate having the formula $NH_2\cdot C_6H_4\cdot N_2\cdot HCrO_4$, which combines at once with phenols and amines to form aminoazo-compounds. *p*-Aminobenzeneazo-β-naphthol (*Trans.*, 1885, 47, 663) has been prepared by this method and characterised by its acetyl derivative, which crystallises in red needles melting at 259—260°. *p*-Aminophenol forms a normal diazonium dichromate, $[HO\cdot C_6H_4\cdot N_2]_2Cr_2O_7$. These solid chromates are all more or less explosive when dry, and it is suggested that some of them might find technical application as high explosives.

DISCUSSION.

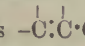
Dr. HEWITT said that the much greater stability of *p*-aminophenyldiazonium salts as compared with salts not containing an amino-group may perhaps be accounted for by assuming that the former compounds have a quinonoid constitution. Professor Meldola's chromate would then have the formula $NH{:}C_6H_4{:}N_2H\cdot HCrO_4$, whilst the stable diazonium sulphate just described by Dr. Cain would have a similar formula, $O{:}C_6H_4{:}C_6H_3(OEt){:}N_2H\cdot HSO_4$.

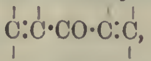
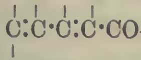
Dr. CAIN inquired whether the diazonium chromate of *p*-nitroaniline had been prepared. It would be interesting to know whether this salt gave the ordinary "*p*-nitraniline red" on cloth padded with β-naphthol or whether the chromic acid had any effect on the colour produced on the fibre.

Prof. MELDOLA, in reply to Dr. Cain, said that he had prepared diazonium chromates of the nitroanilines, but these substances were highly explosive when dry, and dangerous to make in quantity. In the moist state, they might perhaps be used for the purpose indicated. With reference to a question by Dr. Morgan, he had not been able to isolate chromates of the tetrazo-derivatives of simple diamines. With the heteronucleal diamines of the diphenyl series, it might be possible to obtain such tetrazonium chromates, but the experiments had not been carried very far in this direction at present. He agreed with Dr. Hewitt as to the remarkable stability of some of these diazonium chromates, but as to the inference that these salts might have a quinonoid structure on account of their colour, the fact that the acid radicle was itself coloured interfered with this interpretation, although there was no valid objection against such a view of their constitution.

*214. "The combination of mercaptans with olefinic ketonic compounds." By Siegfried Ruhemann.

According to Posner's researches (*Ber.*, 1901, **34**, 1395; 1902, **35**, 799; 1904, **37**, 502), mercaptans generally interact with mono-olefinic ketones in the presence of hydrogen chloride, both by addition at the ethylene linking and by condensation with the ketonic group, to yield trithio-compounds.

The author showed that, on using piperidine or sodium ethoxide as catalytic agents, instead of hydrogen chloride, only additive products of mercaptans with the olefinic ketonic compounds  $-\overset{|}{\mathrm{C}}{:}\overset{|}{\mathrm{C}}\cdot\mathrm{CO}-$ are formed, and several substances of this type have been obtained from benzylideneacetone, ethyl benzylideneacetoacetate, benzylideneacetylacetone, and benzylidenebenzoylacetone.

Moreover, in the presence of piperidine, dibenzylideneacetone, a diolefinic ketone containing the residue  $\underset{|}{\overset{|}{\mathrm{C}}}{:}\overset{|}{\mathrm{C}}\cdot\mathrm{CO}\cdot\overset{|}{\mathrm{C}}{:}\underset{|}{\overset{|}{\mathrm{C}}}$, unites either with 1 or 2 molecular proportions of a mercaptan, whilst Posner, by means of hydrogen chloride, has only been able to obtain additive products with 2 mols. of mercaptans. On the other hand, cinnamylideneacetophenone, a ketone with the grouping  $\underset{|}{\overset{|}{\mathrm{C}}}{:}\overset{|}{\mathrm{C}}\cdot\overset{|}{\mathrm{C}}{:}\overset{|}{\mathrm{C}}\cdot\mathrm{CO}-$, takes up only one molecule of either *iso*amyl mercaptan or phenyl mercaptan; whilst according to Posner, this ketone, under the influence of hydrogen chloride, unites with 2 mols. of mercaptans. The author has, however, obtained from this ketone and phenyl mercaptan a compound identical with the substance described by Posner, but which has the formula $\mathrm{CHPh{:}CH\cdot CH(SPh)\cdot CH_2\cdot COPh}$, and not $\mathrm{CHPh(SPh)\cdot CH_2\cdot CH(SPh)\cdot CH_2\cdot COPh}$, as stated by this investigator.

215. "Studies in optical superposition. Part I." By Thomas Stewart Patterson and Francis Taylor.

Menthyl acetate, *l*-menthyl *d*-tartrate, and *l*-menthyl diacetyl-*d*-tartrate have been prepared and their rotations examined between 0° and 100° and compared with each other and with that of menthol between the same temperatures. Menthyl diacetyltartrate is dimorphous, one modification melting at 84·5° and the other at 108°. It is shown that for menthol there is a temperature (58—59°) of minimum rotation (maximum negative rotation), but no such temperature has been observed for its derivatives. It is shown to be possible by analogy to trace the separate effects of the different active groups composing menthyl tartrate and its diacetyl derivative.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bolton, Henry Carrington. A select bibliography of chemistry, 1492—1902. 2nd supplement. Smith. Mis. Coll. Vol. XLIV. Washington 1904. From the Smithsonian Institution.

Dobbin, Leonard, and Marshall, Hugh. Salts and their reactions. With a preface by A. Crum Brown. pp. 198. Edinburgh 1904.
From the Authors.

Gordon Memorial College, Khartoum. First report of the Wellcome Research Laboratories. By the director, Andrew Balfour. pp. 84 + iii. ill. Khartoum 1904. From the Director.

Haldane, J. S., and Wade, John. Reports to the Local Government Board on the destruction of rats and disinfection on shipboard. pp. 28. ill. London 1904. From the Local Government Board.

Lewkowitsch, J. Cantor lectures on oils and fats: their uses and applications. pp. 52. ill. London 1904. From the Author.

Lewkowitsch, J. Chemical technology and analysis of oils, fats, and waxes. Third edition. pp. 1152. ill. 2 vols. London 1904.
From the Author.

Lodge, Richard W. Notes on assaying, and metallurgical laboratory experiments. pp. viii + 287. ill. New York 1904.
From the Publishers.

Rostoski, O. Manual of serum diagnosis. Authorised translation by Charles Bolduan. pp. 86. ill. New York 1904.
From the Publishers.

Thomson, J. J. Elektrizität und Materie. Autorisierte Übersetzung von G. Siebert. pp. 100. Braunschweig 1904.

From the Publishers.

II. *By Purchase.*

Chemisch-technische Untersuchungsmethoden. Herausgegeben von Georg Lunge. Fünfte Auflage. Bände 1 und 2. pp. xxvi + 953 + xlix, xix + 842 + viii. ill. Berlin 1904.

De la Coux, H. L'ozone et ses applications industrielles. Propriétés physiques—Physiologie—Production—Actions chimique et microbiologique—Applications—Analyse. pp. 557. ill. Paris 1904.

Hager, Hermann. Das Mikroskop und seine Anwendung. Handbuch der praktischen Mikroskopie und Anleitung zu mikroskopischen Untersuchungen. Nach dessen Tode vollständig umgearbeitet und in Gemeinschaft mit O. Appel, G. Brandes, P. Stolper, neu herausgegeben von Carl Mez. Neunte Auflage. pp. xii + 392. ill. Berlin 1904.

Hantzsch, A. Grundriss der Stereochemie. Zweite Auflage. pp. viii + 188. Leipzig 1904.

Kobert, Rudolf. Lehrbuch der Intoxikationen. II Band, 1 Hälfte. Zweite Auflage. pp. 400. ill. Stuttgart 1904.

Schelenz, Hermann. Geschichte der Pharmazie. pp. xi + 935. Berlin 1904.

III. *Pamphlets.*

Borns, H. Die Elektrochemie im Jahre 1903. (From *Die Chemische Industrie*, 27, 1904.)

Chace, Ed. Mackay, Tolman, L. M., and Munson, L. S. Chemical composition of some tropical fruits and their products. I. A study of Cuban fruits. II. The composition of fresh and canned pine-apples. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 87.)

Dymond, T. S., and Bull, B. W. Variation in the milk of a dairy herd during the summer months. pp. 15. Chelmsford 1904.

—— Variation in the milk of a dairy herd during the winter months. pp. 19. Chelmsford 1903.

Dymond, T. S., and Hughes, F. Notes on agricultural analyses, made in the County Technical Laboratories, Chelmsford, during 1901—1903. pp. 50. Chelmsford 1904.

Grindley, H. S. The nitrogenous constituents of flesh. (From *J. Amer. Chem. Soc.*, 26, 1904.)

Haywood, J. K., and Warner, H. J. Arsenic in papers and fabrics. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 86.)

Howard, Albert. Hop experiments, 1904. pp. 29. ill. Kent 1904.

Richardson, Clifford. The constitution of Portland cement from a physico-chemical standpoint. pp. 20. New York 1904.

Storer, F. H. A supplement to the article (No. 3) on the occurrence of mannan in trees, roots, and fruit. (From the *Bulletin of the Bussey Institution*, **3**, 1904.)

Tolman, L. M., and Munson, L. S. Olive oil and its substitutes. (U.S. Dept. of Agric. Bureau of Chemistry Bulletin, No. 77.)

Travers, Morris W. Researches on the attainment of very low temperatures. (From the *Smithsonian Miscellaneous Collections*, **46**, 1904.)

Wiley, Harvey W. The influence of environment upon the composition of the sugar beet, 1902, including a study of irrigated sections. (U.S. Dept. of Agric. Bureau of Chemistry, Bulletin No. 78.)

WISLICENUS MEMORIAL LECTURE.

The Wislicenus Memorial Lecture will be delivered by Professor W. H. Perkin, F.R.S., on **Wednesday**, January 25th, 1905, at **8.30** p.m.

At the next Meeting, on **Wednesday**, January **18th**, 1905, at **5.30** p.m., the following papers will be communicated:—

"Nitrogen halogen derivatives of the sulphonamides. Part I. Sulphondichloroamides and sulphonalkylchloroamides." By F. D. Chattaway.

"Nitrogen halogen derivatives of the sulphonamides. Part II. Sulphondibromoamides and sulphonalkylbromoamides." By F. D. Chattaway.

"Electrolytic oxidation of aliphatic aldehydes." By H. D. Law.

"The diazo-derivatives of the benzenesulphonylphenylenediamines." By G. T. Morgan and F. M. G. Micklethwait.

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Report of the Council.

The Council are glad to be in the position to report that the Society continues to flourish, and that, as measured by the number of papers read, its activity has exceeded that of any previous year.

On the 31st December, 1903, the number of Fellows was 2,700. During 1904, 128 Fellows were elected, and 5 reinstated, making a gross total of 2,833. The Society has lost 28 Fellows by death; 37 have resigned; the elections of 4 have become void; 52 have been removed for non-payment of subscriptions, and 1 Fellow has withdrawn. The total number of Fellows, therefore, on the 31st December, 1904, was 2,711.

The names of the Fellows who have died are:

A. H. Allen.
F. E. Allhusen.
J. Barclay.
Sir I. L. Bell.
F. B. Benger.
C. Beringer.
H. N. Bilimoria.
W. Chattaway.
P. L. Dey.
T. H. Dodd.
W. H. Dodd.
R. E. Doran.
W. Francis.
A. Gibson.
C. G. Grenfell.
H. Grimshaw.
G. Howsam.
T. Isherwood.
J. Jackson.
A. Kitchin.
J. Mason.
D. Munro.
T. A. Pooley.
H. St. John.
C. J. Sawer.
W. H. Stanger.
R. M. W. Swan.
A. W. Williamson.

The following Fellows have resigned :

G. Ansdell.
J. F. Ballard.
J. Bardsley.
H. H. Barker.
G. E. Battle.
J. Baynes.
J. Bottomley.
G. W. Burman.
W. F. Butcher.
J. Caley.
H. M. Chapman.
T. A. Dickson.
E. Dowzard.
J. Edmunds.
T. A. Ellwood.
F. A. Gatty.
H. Gordon.
G. M. Gregory.
H. E. Haddon.
W. Hampton.
E. C. Ibbotson.
A. W. D. Leahy.
A. E. McKenzie.
T. R. Marshall.
W. Marshall.
C. A. Mitchell.
C. S. Purcell.
A. Sandford.
W. Sessions.
M. J. Sheridan.
W. Taverner.
G. Trench.
H. F. Waller.
A. W. Warrington.
A. L. White.
H. F. A. Wigley.
B. Winstone.

Among the Fellows removed by death, the Society mourns the loss of Prof. Alexander W. Williamson, who twice filled the office of President, and to whose initiative the publication of the *Abstracts* was largely due.

The number of Honorary and Foreign Members at the date of the last Annual General Meeting was 30. Six names were added to the list by the election on May 18th, 1904, of Prof. A. H. Becquerel, Prof. C. A. Lobry de Bruyn, Prof. F. W. Clarke, Madame M. Curie, Prof. C. Liebermann, and Prof. E. W. Morley. The Society has to lament the death of one of the newly elected Members, Prof. C. A. Lobry de Bruyn, on July 23rd, 1904. The number of Honorary and Foreign Members, therefore, is 35.

During the year 1904, 215 scientific communications have been made to the Society, 188 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of *Transactions* for 1904 contains 175 memoirs, occupying 1,761 pages, whilst that for the preceding year contains 142 memoirs, which occupy 1,490 pages.

The *Journal* for 1904 contains also 4,617 abstracts of papers published mainly in foreign journals, which extend to 1,920 pages, whilst the abstracts for 1903 numbered 3,882 and occupied 1,640 pages.

The abstracts for 1904 may be classified as follows :

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	1072	1968

Part II.

General and Physical Chemistry		606
Inorganic Chemistry..........................		541
Mineralogical Chemistry		132
Physiological Chemistry		501
Chemistry of Vegetable Physiology and Agriculture		311
Analytical Chemistry		558
	848	2649
Total in Parts I. and II.	1920	4617

Owing to the great increase in the number of papers abstracted, it has become necessary to add to the editorial staff. Dr. C. H. Desch has been appointed Assistant Sub-editor, with the object of taking part in the preparation of abstracts for the press, and of relieving Mr. Greenaway of a portion of the clerical work.

Although an award of the Faraday Medal was made in 1895, fifteen years have elapsed since the delivery of the last Faraday Lecture. On April 19, 1904, the Lecture was delivered by Professor Ostwald, in the Lecture theatre of the Royal Institution, the use of which had been kindly granted by the Managers for the occasion. The subject of the Lecture was "Elements and Compounds."

The Wislicenus Memorial Lecture was delivered by Prof. W. H. Perkin on January 25th of the present year.

On the occasion of the celebration of the Jubilee of the Doctorate of Sir Henry E. Roscoe, a Past President of the Society, on April 22, 1904, the Council welcomed the opportunity of sending an address of congratulation to him.

Proposals have been received from the Chemical, Metallurgical, and Mining Society of South Africa, and from the American Chemical Society, for a reciprocal exchange of Journals for members of each of these Societies and of the Chemical Society at a rate just sufficient to cover the cost of printing, addressing, and postage. After careful consideration, the Council were unable to accede to the proposals, as the effect on the finances of the Society could not be estimated, and a limit could not be set to the number of Societies which might seek the benefit of a similar exchange of Journals.

The question of co-operation in the preparation of Abstracts in English has been raised afresh by the American Chemical Society by the appointment of a committee to confer with the Chemical Society on this important subject. The Council have reappointed the Committee which discussed the possibility of co-operation in 1899, and await the proposals of the American Committee with every desire to consider their practicability.

Acting on the suggestion made in the Presidential address at the last Annual General Meeting, the Council have arranged for the preparation and publication of a series of Reports on the advance made each year in chemistry. These reports will be issued early in each year, and it is hoped that they will prove to be of value not only to the Fellows, but to students of chemistry generally.

Obituary notices of several deceased Past Presidents have not as yet been published. These notices have now been received and are in type. Among them is included an obituary notice of Sir Edward Frankland, as the Council have been unable to obtain the manuscript of the Memorial Lecture, delivered on October 31st, 1901.

A further increase in the use of the Library has to be recorded, 1,057 books being borrowed during 1904, as against 991 during the previous year. The additions to the Library comprise 119 books, of which 67 were presented, 296 volumes of periodicals, and 52 pamphlets, as against 126 books, 271 volumes of periodicals, and 43 pamphlets last year. An alteration in the wording of Library Rule IV. has been made to enable new books to be borrowed at an earlier date than formerly.

The Society has been the fortunate recipient of the eudiometer used by the late Sir Edward Frankland in the analysis of ethyl in 1849, presented by Professor Frankland; of a bronze medal of Roger Bacon, presented by Mr. Oscar Guttmann; and of an engraving of Berzelius, presented by Professor Retzius, of Stockholm.

A special Committee was appointed last June to revise the Byelaws, and reported in due course to the Council. The revised Byelaws were submitted by the Council to the Society for consideration at an Extraordinary General Meeting on February 8th, but failed to secure acceptance, being referred back for further consideration.

A memorial, bearing the signatures of nineteen women engaged in chemical work, praying for the admission of women to the Fellowship of the Society, has been under consideration. The Council were advised that "married women are not eligible for election as Fellows of the Society; that it is extremely doubtful whether the Charter admits of the election of unmarried women as

Fellows; that it would not be wise to elect even unmarried women without first applying for a supplemental Charter; and that the election of women as Associates would be legal after a modification of the Bye-laws expressly authorising their election." An alteration in Bye-law III. extending the privileges of the Associateship to women accordingly formed one of the changes in the Bye-laws recently proposed by the Council.

The third Report of the Joint International Committee on Atomic Weights, with its revised table of atomic weights, has been issued to the Fellows in the *Proceedings*.

Grants amounting in all to £215 have been made during the year from the Research Fund, and £26 16*s*. 6*d*. has been returned. Of the papers published in the *Transactions* during 1904, thirty-two were contributed by authors to whom grants had been made from the Research Fund.

The total income of the Society for the year 1904 was £6700 5*s*. 8*d*. and the expenditure £5982 14*s*. 6*d*.; in 1903, these were £6817 19*s*. 7*d*. and £5926 18*s*. 3*d*. respectively, so that whilst the income has fallen by £117 13*s*. 11*d*., the expenditure has risen by £55 16*s*. 3*d*. A glance at the balance sheet for 1903, however, shows receipts amounting to £257 which cannot be regarded truly as income from normal sources; in 1904 only £5 was so received. Allowing for these items, the income for 1904 shows an increase over that of 1903 of £134 6*s*. 1*d*.

The Treasurer's chief anxiety is due to the ever-increasing size of the *Journal* and the corresponding increase in cost. Both exceed those of 1903, the size by about 17 per cent. and the cost by about 10 per cent., the excess due to printing alone in 1904 amounting to £280 12*s*. 1*d*., whilst the total increase in cost reaches the large sum of £365 6*s*. 11*d*. Part of this is due to the fact that the January number for 1904 contained a double set of Abstracts, thus leading to an increase both in Abstractors' fees and in printing, these two items really representing thirteen months instead of twelve. As pointed out by the President on resigning the Treasurership two years ago, the steady increase in the size and cost of the *Journal* seems to render it inevitable "that, in the "near future, some more stringent regulations both as to the state of "the manuscript and the dimensions of the papers will have to be "imposed" if the Society is to carry on its work of publication efficiently. In addition to the cost of the *Journal*, there is in the present accounts a sum of £237 6*s*. 0*d*. for the printing of Vol. IV, Part 1 (Authors) of the Collective Index (1893—1902). On the other hand, there has been a saving of £42 14*s*. 5*d*. in the cost of the *Proceedings*. The Library has cost less by the sum of £150 13*s*. 3*d*., and the general administrative expenses, which in 1903 were abnormally high, have fallen from £1138 5*s*. 5*d*. to £893 1*s*. 0*d*., a saving of £245 4*s*. 5*d*., notwithstanding the cost of introducing house telephones and also connecting the Society with the Post Office system.

The Treasurer reports that the new system of keeping the Society's accounts has been in full working order for two years and has been found most satisfactory in every way.

The Council desire to place on record their appreciation of the valuable services rendered to the Society by Professor Wynne, and an expression of their regret that his removal from London obliges him to relinquish the office of Senior Secretary. By placing him among the Vice-Presidents, it is hoped that the Society may continue to receive the advantage of his experienced co-operation in the work of the Council.

BALANCE SHEET.—THE CHEMICAL SOCIETY, 31ST DECEMBER, 1904.

Liabilities.

	£	s.	d.	£	s.	d.
To Subscriptions received in advance				257	0	0
,, Sundry Creditors				895	9	6
,, Research Fund :—						
As per last Balance Sheet	6742	10	1			
Add Excess of Income over Expenditure for the year	42	7	7			
				6784	17	8
,, Chemical Society :—						
As per last Balance Sheet...	17981	10	4			
Add Excess of Income over Expenditure for the year	717	11	2			
				18699	1	6
(The liability in respect of Life Compositions is not included.)						
				£26636	8	8

Assets.

	£	s.	d.	£	s.	d.
By Investments (value when acquired) :—						
£1050 London and North Western Railway 3 per cent. Debenture Stock	839	12	0			
£6730 Metropolitan Consolidated 3½ per cent. Stock	7212	8	6			
£1520 14*s*. 3*d*. Cardiff Corporation 3 per cent. Stock	1650	0	0			
£1400 India 2½ per cent. Stock	1316	1	0			
£2400 Bristol Corporation 2½ per cent. Debenture Stock	2070	2	0			
£2358 Midland Railway 2½ per cent. Preference Stock	2072	8	0			
£1200 Leeds Corporation 3 per cent. Stock	1143	1	0			
£1500 Transvaal 3 per cent. Guaranteed Stock ...	1460	13	6			
				17764	6	0
(Estimated present value of Investments, £16,743 12*s*. 4*d*.)						
,, Library Furniture, Stock of Publications, &c. (not valued)						
,, Sundry Debtors :—						
Society of Public Analysts	11	0	6			
Advertising Agents	57	16	1			
Messrs. Gurney & Jackson	373	9	2			
Telephone Deposit	1	0	0			
				443	5	9
,, Subscriptions in Arrear. Estimated to realise				330	0	0
,, Insurance paid in advance				37	14	3
,, Cash :—						
Deposit Account...	1300	0	0			
Less Overdraft on Current Account	41	11	9			
	1258	8	3			
In hand	17	16	9			
				1276	5	0
,, Research Fund :—						
Investments (value when acquired):						
£1000 North British 4 per cent. No. 1 Preference Stock	1010	0	0			
£4400 Metropolitan Consolidated 3½ per cent. Stock	4587	18	0			
£1034 Great Western Railway 2½ per cent. Debenture Stock	1049	15	11			
	6647	13	11			
,, Cash at Bank	137	3	9			
				6784	17	8
(Estimated present value of Research Fund Investments, £6670 17*s*. 2*d*.)						
				£26636	8	8

INCOME AND EXPENDITURE ACCOUNT

Income.

		£	s.	d.	£	s.	d.
To Life Compositions		370	0	0			
,, Admission Fees		556	0	0			
,, Annual Subscriptions		4307	0	0			
,, Cash on account of Subscriptions and Fees of past years, per Mr. R. Steele		5	0	0	5238	0	0
,, Investments :—							
Dividends on £6,730 Metropolitan Consolidated 3½ per cent. Stock ...		224	5	6			
£1,050 London and North Western Railway 3 per cent. Debenture Stock		30	0	6			
£1,520 14*s.* 3*d.* Cardiff Corporation 3 per cent. Stock ...		43	8	7			
£1,400 India 2½ per cent. Stock		33	6	6			
£2,358 Midland Railway 2½ per cent. Preference Stock		56	3	10			
£2,400 Bristol Corporation 2½ per cent. Debenture Stock		57	0	0			
£1,200 Leeds Corporation 3 per cent. Stock		34	5	6			
£1,500 Transvaal 3 per cent. Guaranteed Stock		42	15	0			
Income Tax Recovered (two years)		48	2	8			
Interest on Deposit Account		20	0	9	589	8	10
,, Publications:—							
Sales :							
Journals		748	8	9			
Proceedings		15	18	6			
General Index		79	15	6			
Memorial Lectures		14	13	4			
Library Catalogue		3	16	6			
Atomic Weight Tables		1	2	7			
Jubilee Volume		0	6	0			
		864	1	2			
Less Publishers' Commission		84	5	8			
		779	15	6			
Proceeds of Advertisements in Journal...	£85 8 3						
Less Commission	12 16 5						
		72	11	10	852	7	4
,, Subscriptions from other Societies :—							
Society of Chemical Industry		9	9	0			
Society of Public Analysts		11	0	6	20	9	6
					£6700	5	8

I have examined the above Accounts with the Books and Vouchers of the Society, and and the Investments.

W. B. KEEN,
Chartered Accountant.

9th March, 1905.

FOR THE YEAR ENDED 31ST DECEMBER, 1904.

Expenditure.

	£	s.	d.	£	s.	d.
By Expenses on account of Journal and Proceedings :—						
Salary of Editor	300	0	0			
Salary of Sub-Editor	200	0	0			
Salary of Indexer	80	0	0			
Editorial Postages, &c.	19	10	1			
Abstractors' Fees	482	10	2			
Printing of Journal	2203	7	11			
Printing of Advertisements	29	3	0			
Printing of Wrappers	112	15	0			
Distribution of Journal	425	3	11			
Authors' Copies	109	19	6			
				3962	9	7
Printing of Proceedings	183	9	5			
Distribution of Proceedings	32	4	9			
				215	14	2
,, Purchase of Back Numbers of Journal				15	4	5
,, List of Fellows				67	4	6
,, Collective Index :—						
Printing Vol. IV., Part I.	237	6	0			
Salaries	133	15	8			
				371	1	8
,, Library Expenses :—						
Salary of Librarian	100	0	0			
Books and Periodicals	242	5	10			
Binding	53	18	4			
				396	4	2
,, Indexing for International Catalogue				30	0	0
,, Faraday Lecture, Honorarium	25	0	0			
,, Faraday Lecture, Expenses	4	2	6			
				29	2	6
,, Illuminated Address to Sir H. E. Roscoe				2	12	6
,, Administrative Expenses :—						
Tea Expenses	26	13	5			
Salary of Assistant Secretary	150	0	0			
Salary of Office and Library Assistant	40	6	0			
Wages (Commissionaire, Housekeeper, and Charwoman)	137	6	3			
Pension, Mrs. Hall	30	0	0			
Coal and Lighting	42	13	7			
House Expenses and Repairs	77	2	9			
House Telephones	32	10	0			
Insurance	6	17	2			
Accountants' Charges	10	10	0			
Accountants' Commission on Recovery of Income Tax	3	9	4			
Legal Charges	16	1	6			
Miscellaneous Printing	81	7	6			
Stationery	45	15	1			
Furniture	39	3	6			
Postages	106	17	7			
Indexing Council Minutes	15	15	0			
Miscellaneous Expenses	30	12	4			
				893	1	0
,, Balance, being Excess of Income over Expenditure, carried to Balance Sheet				717	11	2
				£6700	5	8

certify them to be in accordance therewith. I have also verified the Balance at the Bankers

Approved— John Wade, E. Grant Hooper, Hy. Forster Morley, } *Auditors.*

Research Fund Income and Expenditure Account for the Year ended 31st December, 1904.

Income.

	£	s.	d.	£	s.	d.
To Dividends:—						
On £4400 Metropolitan Consolidated 3½ per cent. Stock	146	12	6			
On £1000 North British Railway 4 per cent. No. 1 Preference Stock	38	2	3			
On £1034 Great Western Railway 2½ per cent. Debenture Stock	24	12	9			
				209	7	6
,, Repayment of Research Grants:—						
H. E. W. Phillips	20	14	1			
F. E. Matthews	1	2	5			
H. A. Auden	5	0	0			
				26	16	6
,, Repayment of Income Tax (2 years)				21	3	7
				£257	7	7

Expenditure.

	£	s.	d.	£	s.	d.
By Grants to—						
J. B. Cohen	15	0	0			
A. W. Crossley	10	0	0			
F. E. Francis	10	0	0			
A. Lapworth	15	0	0			
H. R. Le Sueur	10	0	0			
T. M. Lowry	10	0	0			
R. S. Morrell	10	0	0			
R. H. Pickard	10	0	0			
C. Smith	5	0	0			
J. J. Sudborough	20	0	0			
G. Tattersall	10	0	0			
J. F. Thorpe	10	0	0			
R. D. Abell	5	0	0			
H. D. Dakin	10	0	0			
A. McKenzie	25	0	0			
J. W. Mellor	10	0	0			
H. A. Miers	20	0	0			
W. E. S. Turner	5	0	0			
F. G. Pope	5	0	0			
				215	0	0
,, Balance, being excess of Income over Expenditure, carried to Balance Sheet				42	7	7
				£257	7	7

I have examined the above Account with the Books and Vouchers of the Society, and certify it to be in accordance therewith. I have also verified the Balance at the Bankers and the Investments.

W. B. Keen,
Chartered Accountant.

9th March, 1905.

Approved—
John Wade,
E. Grant Hooper,
Hy. Forster Morley,
Auditors.

LIST

OF THE

OFFICERS AND FELLOWS

OF THE

CHEMICAL SOCIETY.

CORRECTED TO OCTOBER, 1904.

BURLINGTON HOUSE,
LONDON, W.
1904.

OFFICERS AND COUNCIL,
ELECTED MARCH 23rd, 1904.

PRESIDENT.

WILLIAM AUGUSTUS TILDEN, D.Sc., F.R.S.

VICE-PRESIDENTS

WHO HAVE FILLED THE OFFICE OF PRESIDENT.

HENRY EDWARD ARMSTRONG, Ph.D., LL.D., F.R.S.
ALEXANDER CRUM BROWN, D.Sc., LL.D., F.R.S.
Sir WILLIAM CROOKES, D.Sc., F.R.S.
Sir JAMES DEWAR, M.A., LL.D., F.R.S.
AUGUSTUS G. VERNON HARCOURT, M.A., D.C.L., F.R.S.
HUGO MÜLLER, Ph.D., LL.D., F.R.S.
WILLIAM ODLING. M.A., M.B., F.R.S.
WILLIAM HENRY PERKIN, Ph.D., LL.D., F.R.S.
J. EMERSON REYNOLDS, Sc.D., M.D., F.R.S.
Sir HENRY ENFIELD ROSCOE, LL.D., F.R.S.
WILLIAM JAMES RUSSELL, Ph.D., F.R.S.
THOMAS EDWARD THORPE, C.B., LL.D., F.R.S.

VICE-PRESIDENTS.

HORACE TABBERER BROWN, LL.D., F.R.S.
HAROLD BAILY DIXON, M.A., F.R.S.
WYNDHAM ROWLAND DUNSTAN, M.A., LL.D., F.R.S.
PERCY FARADAY FRANKLAND, LL.D., F.R.S.
DAVID HOWARD.
RAPHAEL MELDOLA, F.R.S.

SECRETARIES.

WILLIAM PALMER WYNNE, D.Sc., F.R.S.
MARTIN ONSLOW FORSTER, D.Sc., Ph.D.

FOREIGN SECRETARY.

Sir WILLIAM RAMSAY, K.C.B., LL.D., F.R.S.

TREASURER.

ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

OTHER MEMBERS OF COUNCIL.

AUGUSTUS EDWARD DIXON, M.D.
JAMES JOHNSTONE DOBBIE, M.A., D.Sc., F.R.S.
BERNARD DYER, D.Sc.
ALFRED DANIEL HALL, M.A.
ARTHUR HARDEN, D.Sc., Ph.D.
JOHN THEODORE HEWITT, M.A., D.Sc.
CHARLES ALEXANDER KOHN, Ph.D., M.Sc.
ARTHUR LAPWORTH, D.Sc.
JAMES ERNEST MARSH, M.A.
EDMUND JAMES MILLS, D.Sc., F.R.S.
SIEGFRIED RUHEMANN, M.A., Ph.D.
JOHN MILLAR THOMSON, LL.D., F.R.S.

EDITOR OF THE SOCIETY'S JOURNAL.

G. T. MORGAN, D.Sc.

SUB-EDITOR OF THE SOCIETY'S JOURNAL.

A. J. GREENAWAY.

ASSISTANT SECRETARY.

S. E. CARR.

LIBRARIAN.

F. W. CLIFFORD.

Telephone Number:
1368, MAYFAIR.

THE CHEMICAL SOCIETY.

The Chemical Society was founded on February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice of the same from the Secretaries.

Each Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications so long as his Annual Subscription be not in arrear. He is also entitled to the use of the books in the Society's Library, under such restrictions as the Council may deem necessary. He has the privilege of introducing two visitors to Ordinary Meetings of the Society, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

When elected, every Candidate previous to admission, is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due on the first day of January of every year. The life composition fee is £30, excepting that Fellows who have paid ten annual subscriptions pay as life composition fee £20; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If, however, a Candidate be elected during the month of November or December, he will not be called upon to pay any annual subscription for the current year, and will not be entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March shall owe two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, ceases to be a Fellow of the Society, and his name will be removed from the Society's List accordingly: Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

PUBLICATIONS OF THE SOCIETY.

The following is a list of the Publications of the Society:

Memoirs and Proceedings, 1841—47, 3 vols.
Quarterly Journal, 1848—64, 14 vols.
Journal, 1862—present date.
Proceedings, 1885—present date.

The Society has also issued General Indexes to its publications, 1841—72, price 4/-; 1873—82, price 16/- (11/-, post free, to Fellows); 1883—92, price 21/- (16/-, post free, to Fellows); 1893—1902, price 30/- (21/-, post free, to Fellows); the Jubilee Volume, 1891, price 6/-; Library Catalogue, 1903, price 2/6; a volume of Memorial Lectures, 1893—1900, price 7/6; and Tables of the Atomic Weights recommended by the International Atomic Weights Committee, price 1/6 per doz., 12/- per hundred.

The Journal and Proceedings are sold to non-Fellows of the Society at a price of £2 and 7/6 per annum respectively.

The *Journal*, which is issued monthly, contains papers communicated to the Society, Memorial Lectures on the life and work of eminent foreign Fellows deceased, together with abstracts of all papers relating to chemistry and closely connected branches of science published in other journals, British and foreign.

The *Proceedings* contains a short report of the business at each meeting, and abstracts of all papers presented to the Society. It is usually published about seven days after the meeting. It serves as a medium of publication, not only for the abstracts of papers which subsequently appear in full in the Journal, but also for short papers and preliminary communications.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have decided that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. Papers which, on the report of referees, are deemed by the Council unsuitable for publication in the Transactions, are deposited in the Society's Archives. In all cases, an abstract of the paper, not exceeding three hundred words in length, should be supplied for insertion in the Proceedings.

Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. The Committee meets twice a year to consider applications for grants, and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. S., Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath, Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
May 18, 1904	Becquerel, Prof. Antoine Henri, 6, Rue Dumont d'Urville, XVI. Paris
Feb. 1, 1883	Beilstein, Prof. Dr. F., W.O., 8th line, No. 17, St. Petersburg
Mar. 1, 1860	Berthelot, Prof. M., Membre de l'Institut, F.R.S., Collège de France, Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. S., F.R.S., Reale Università, Rome
May 18, 1904	Clarke, Prof. Frank Wigglesworth, U.S. Geological Survey, Washington, D.C., U.S.A.
Feb. 1, 1883	Cleve, Prof. Dr. P. T., Universitet, Upsala
May 18, 1904	Curie, Madame Marie, La Sorbonne, Paris
Jan. 20, 1898	Curtius, Geh. Rath, Prof. Dr. T., Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. E., Aschaffenburg, Germany
June 16, 1892	Fischer, Geh. Rath, Prof. Dr. Emil, F.R.S., Dorotheenstr. 10, Berlin
Feb. 1, 1883	Fittig, Prof. Dr. R., Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. A. P. N., Rapenburg 104, Leyden
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Université, Geneva
Feb. 2, 1888	Hoff, Prof. Dr. J. H. van't, F.R.S., Lietzenburgerstrasse 54, Berlin, 15, W.
Jan. 20, 1898	Körner, Prof. W., R. Scuola superiore d'agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath, Prof. Dr. A., Kaiser Wilhelmstrasse 43, Breslau
Feb. 2, 1888	Landolt, Prof. Dr. H., Albrechtstrasse 14, Berlin, N.W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Wasagasse 9, Vienna
May 18, 1904	Liebermann, Geh. Rath, Prof. Dr. Carl, Matthäikirchstrasse 29, Berlin, W.
Feb. 1, 1883	†Mendeléeff, Prof. Dr. D. I., F.R.S., 19 Zabalkansky, St. Petersburg

* Faraday Lecturer, 1872.

† Faraday Lecturer, 1889.

Date of Election.	
Jan. 20, 1898	Menschutkin, Prof. Dr. N., Sosnovka, Polytechnikum, St. Petersburg
Jan. 20, 1898	Moissan, Prof. Henri, Rue Vauquelin 7, Paris
May 18, 1904	Morley, Prof. Edward Williams, Adelbert College, Cleveland, Ohio, U.S.A.
Jan. 20, 1898	*Ostwald, Prof. Dr. W., Linnéstrasse 2/3, Leipzig
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Th., Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. W., Rue Beckmann 32, Liége
May 18, 1876	Thomsen, Prof. Dr. Julius, F.R.S., Lindevei 13, Copenhagen
Jan. 20, 1898	Troost, Prof. L. J., Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. J. D. van der, T.C., Hooftstraat 117, Amsterdam

* Faraday Lecturer, 1904.

FARADAY LECTURERS.

1869.	J. B. A. Dumas.
1872.	S. Cannizzaro.
1875.	A. W. von Hofmann.
1879.	A. Wurtz.
1881.	H. von Helmholtz.
1889.	D. Mendeléeff.
1895.	Lord Rayleigh.
1904.	W. Ostwald.

LONGSTAFF MEDALLISTS.

1881.	T. E. Thorpe.
1884.	C. O'Sullivan.
1888.	W. H. Perkin.
1891.	F. R. Japp.
1894.	H. T. Brown.
1897.	W. Ramsay.
1900.	W. H. Perkin, junr.
1903.	W. J. Pope.

Any inaccuracies in this list should be reported to The Secretaries, Chemical Society, Burlington House, W.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society ; V.P. as Vice-President ;
S. as Secretary ; T. as Treasurer ; F.S. as Foreign Secretary ; P. as President.

Date of Election.			
1904	Trans.		Abell, Robert Duncombe, D.Sc. (Wales), Ph.D. (Leipzig), University College of South Wales and Monmouthshire, Cardiff
1871	Trans.	C. 1882-4	Abney, Sir W. de W., K.C.B., D.C.L. (Dun.), D.Sc. (Vict.), Sc.D. (Dub.), F.R.S., F.R.A.S., F.R.G.S., Rathmore Lodge, Bolton-gardens South, S.W.
1883			Abraham, Alfred C., 87, Bold-street, Liverpool
1890			‖Abrines, G. Anthony, Sanitary Commissioner's Office, Gibraltar
1904			Ackroyd, John Prest, B.Sc. (Lond.), 116, Richmond-street, Accrington, Lancs.
1897	Trans.		Ackroyd, William, F.I.C., 9, Grandsmere-place, Halifax, Yorks
1875	Trans.		Acworth, Joseph John, Ph.D., F.I.C., Thornbank, Shootup Hill, Brondesbury, N.W.
1892			Adams, Arthur, Kelvin House, Edgbaston-road, Smethwick
1888			Adams, Charles M., Albany-buildings, Lord-street, Southport
1877	Trans.		‖Adams, M. A., F.R.C.S., The Kulm, Bearsted, near Maidstone
1901			Adams, O. G., School of Mines, Thames, Auckland, New Zealand
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helens, Lancs.
1896			Addie, Robert, Messrs. Kennedy and Addie, Norfolk House, Laurence Pountney Hill, E.C.
1889	Trans.		Addyman, F. Thornton, B.Sc. (Lond.), St. George's Hospital, Hyde Park, S.W.
1881	Trans.		Adeney, W. E., D.Sc., A.R.C.S., Royal University of Ireland, Earlsfort-terrace, Dublin
1885	Trans.		Adie, R. Haliburton, B.Sc., M.A., 136, Huntingdon-road, Cambridge
1885			Adriance, John S., Ph.D., 105, East Thirty-ninth-street, New York, U.S.A.
1901			Aitken, A. C., 255, Pollokshaws-road, Glasgow
1879			Albright, George Stacey, Bromesberrow-place, Ledbury
1893			Albuquerque, John Pedrozo d', Prof., M.A., F.I.C., Government Laboratory, Barbados, West Indies

Date of Election.		
1885		Alcock, Frank Harris, 9, Broad-street Corner, Birmingham
1892		Alcock, John W., Central Brewery, 45, Mott-street, Birmingham
1902		Alder, John Frederick, 13, Priestwood-mansions, Highgate, N.
1903		Alderton, Gilbert John, B.Sc. (Lond.), A.I.C., "The Nest," Eglington-road, Plumstead, Kent
1888	Proc.	Alexander, John, M.A., Midfield, Perth
1882		Alford, Henry James, M.D., 1, Hovelands-terrace, Taunton
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1896		Allan, John, 55, Northern-grove, West Didsbury, near Manchester
1894		Allen, F. J., Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, F. T., B.Sc., Higher Grade School, Carlisle
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1894		Allibon, G. H., 19, Short Strand, Belfast
1899		Allworthy, J. H., Sir Roger Manwood's School, Sandwich, Kent
1899		‖Allworthy, S. W., M.A., M.D., The Manor House, Antrim-road, Belfast
1903		Alton, William Lester St. John, A.I.C., "Dungarvan," Putney Heath, S.W.
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. (Oxon.), 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc., 31a, Clanricarde-gardens, W.
1895		Anderson, H., Royal Latin School, Buckingham
1900		Anderson, James William, The Paddock, Halling, near Rochester
1901		Anderson, W. Carrick, M.A., D.Sc., 2, Florentine-gardens, Hillhead, Glasgow
1892		Anderson, William Smellie, Christmas Island, c/o Messrs. Boustead & Co., Singapore, India
1888		Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882		Andrews, L. W., Ph.D., The University, Iowa City, Iowa, U.S.A.
1870		Andrews, Thomas, F.R.S., M.I.C.E., Ravencrag, Wortley, near Sheffield
1877		Angell, John, 6, Beacon's Field, Derby-road, Withington, Manchester
1898	Trans.	Annable, H. W. Coupe-, Tungsten and Rare Metals Co., Ltd. Queen's-road, Battersea, S.W.
1876		Ansdell, Gerrard, Sand Hill Cottage, Dinton, near Salisbury
1879		Appleby, Herbert, 2, John Dalton-street, Manchester
1903		Appleyard, George Henry, Wilmington Oil Mills, 151, Cleveland-street, Hull

Date of Election			
1890	Trans.		‖Appleyard, James Robert, Royal Technical Institute, Salford
1904			Appleyard, Percy, Albany, Western Australia
1897	Trans.		Arbuckle, William, Old Bank House, Jarvey-street, Bathgate, N.B.
1884			Archbutt, Leonard, The Yews, Madeley-street, Derby
1875			Armistead, William, M.B., C.M., Stapleford, Cambridge
1900	Proc.		Armitage, F. P., Colet House, Talgarth-road, W. Kensington, W.
1903	Trans.		‖Armstrong, Edward Frankland, Ph.D. (Berlin), 55, Granville Park, Lewisham, S.E.
1900			Armstrong, F. W., 6, St. Thomas's-terrace, Wells, Somerset
1870	Trans.	C. 1873-5 S. 1875-93 P. 1893-5	‖Armstrong, Henry Edward, Prof., LL.D., Ph.D., F.R.S., 55, Granville Park, Lewisham, S.E., and Central Technical College, Exhibition-road, S.W.
1894			Ashcroft, J. B., Christ Church Schools, Derby
1894			Ashdown, Charles H., F.R.G.S., Monastery-close, St. Albans
1903			Ashdown, Herbert Henry, 3, Genesta-road, Plumstead, Kent
1902			Ashe, James S., 77, Moyne-road, Rathmines, Dublin
1900			Ashton, James, Hacken Sewage Works, Moses Gate, Bolton
1897			Ashworth, J. B., Bridge Cottage, Broad Green, Liverpool
1901			Aspinall, Thomas, 42, Gilnow-road, Bolton
1900	Trans.		Aston, Bernard Cracroft, N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, W. G., 12, Douglas-road, Goodmayes, Ilford, E.
1903			Atkinson, Edwin Bayles, Furze Glen, Lambert-road, Grimsby
1899			Atkinson, G. D., c/o Messrs. Alton & Co., Ltd., Wardwick Brewery, Derby
1903			Atkinson, Harford Montgomery, B.Sc. (Wales), Ph.D. (Göttingen), 7, College-gardens, Belfast
1872	Trans.		‖Atkinson, R. W., B.Sc., 44, Stuart-street, Cardiff
1862	Trans.	C. 1874-8	‖Attfield, John, Prof., M.A., Ph.D., F.R.S., Ashlands, Watford, Herts.
1904	Trans.		Attwell, Herbert Moore, A.R.C.S., Beckhythe, Overstrand, Cromer
1872	Trans.		‖Attwood, George, F.G.S., A.M.I.C.E., Durmast Lodge, Ringwood, Hants, and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1903			Aubrey, Henry James, The Cross, Worcester
1895	Trans.		‖Auden, H. A., Central Laboratory, United Alkali Co., Widnes, Lancs.
1886			Audley, James A., B.Sc., A.R.C.S., F.I.C., c/o Messrs. G. Howson and Sons, Eastwood Sanitary Works, Hanley, Staffs.
1877			Austen, Peter T., Ph.D., 218, St. John's-place, Brooklyn, N.Y., U.S.A.
1892			Avery, David, Working Men's College, Melbourne, Australia

Date of Election.			
1896			Aykroyd, H. E., Glen Rosa, The Grove, Ilkley, Yorks.
1891			Aylan, John Charles, Manager Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1904			‖Badcock, William Cornish, M.A. (Cantab.), The Grammar School, Crediton, Devon
1904			Baguley, Allan, B.Sc. (Wales), University College of N. Wales, Bangor
1875	Trans.		‖Bailey, G. H., Ph.D., D.Sc., Owens College, Manchester, and Marple Cottage, Marple, Cheshire
1895			Bailey, G. P., M.A., Victoria Institute, Worcester
1903			Bailey, Harold James, Maritime Coke Works, Pontypridd, S. Wales
1893			Bailey, Henry, 18, Lavender-sweep, S.W.
1898			Bailey, W. M., M.A., Penrhyn, Ty'rfran, Llanelly
1900			Bain, A. W., B.A., 2, Muswell Rise, Highgate, N.
1884			‖Bain, Daniel, United Alkali Co., Ltd., Allhusen's Works, Gateshead-on-Tyne
1891			Bairstow, John, Burley, Queen's Park, Chester
1901			Baker, Arthur, 130, Walmersley-road, Bury, Lancs.
1889			‖Baker, Charles Frederic, B.Sc., Ph.D., Technical College, Sunderland
1883	Trans.		‖Baker, Charles J., The Schools, Shrewsbury
1899			Baker, Clement Harrison, 70, Blenheim-road, Moseley
1902			Baker, Frederick Guy Stirling, Marryatt's Lodge, Snaresbrook, Essex
1900			Baker, F. Nolan, Lieut., c/o Messrs. Charles Cammell and Co., Ltd., Coventry, Birmingham
1881	Trans.		Baker, Harry, Epworth House, Moughland-lane, Runcorn, Cheshire
1884	Trans.	C. 1899-03	‖Baker, H. Brereton, M.A., F.R.S., Christ Church, Oxford
1893	Trans.		Baker, Julian L., 7, Addison-road, Bedford Park, W.
1901			Baker, T. T., 92a, Villiers-road, Willesden Green, N.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon
1902			Ball, James Handby, B.Sc., Rathbane Cottage, Limerick, Ireland
1897	Trans.		Ball, John, Ph.D., F.G.S., A.M.I.C E., Geological Survey Office, Public Works Department, Cairo, Egypt
1897			Ball, William, 54, Stretton-road, Leicester
1901	Proc.		Ball, W. C., B.A., Guy's Hospital, S.E.
1892			‖Ballantyne, Horatio, 75, Chancery-lane, W.C.
1884			Ballard, J. Farrow, Fern Lodge, Trinity-road, Birchfield, Birmingham
1896			Ballingall, William, Ardarrock, Dundee
1891	Trans.		Baly, Edward Charles Cyril, University College, Gower-street, W.C.

Date of Election.			
1886			Bamber, H. K. G., Ingress House, Greenhithe, Kent
1890	Proc.		Bamber, M. Kelway, The Laboratory, Hyde-park-corner, Colombo, Ceylon
1896			Banerjee, Gopal Ch., Kaiser Soap Co., Cawnpore, India
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, 59, Tregunter-road, S. Kensington, S.W.
1904	Trans.		Barbour, William, M.A., B.Sc., Bell Cottage, Great Oakley, near Harwich
1880			Barclay, Arthur E., 95, Farringdon-street, E.C.
1877			Bardsley, Joshua, F.I.C., Milnshaw House, Accrington, Lancs.
1903	Trans.		‖Barger, George, M.A. (Cantab.), D.Sc. (Lond.), The Wellcome Physiological Research Laboratories, Brockwell Hall, Herne Hill, S.E.
1901			Barker, Hubert H., St. Méthode Post Office, Lake St. John, Quebec, Canada
1903			Barker, Thomas Vipond, Exeter College, Oxford
1896			Barker, W. H., B.Sc., Addiscombe, Empress-avenue, Wanstead Park, Essex
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1894			Barlet, Stéphane, B.Sc., 47, Bassett-road, N. Kensington, W.
1897			Barlow, H. W. L., M.A., M.D. (Oxon.), Holly Bank, Croftsbank-road, Urmston, Manchester
1897			Barlow, William, The Red House, Stanmore, Middlesex
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W., and Dynamite Works, Modderfontein, near Zuurfontein, S. Africa
1875			‖Barnes, R. L., Phœnix Chemical Works, Hackney Wick, N.E.
1888			Barraclough, William H., F.I.C., Mortomley, near Sheffield
1895			Barralet, E. S., 4, Kenyon-mansions, Queen's Club Gardens, W.
1891			Barratt, J. Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward L., B.Sc., 12, Avenue de la Grande Armée, Paris
1901			Barrie, T. S., 157, St. Vincent-street, Glasgow
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, J. A., Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc., Ph.D., College of the City of New York, New York, U.S.A.
1864	Trans.	C. 1870-3, 90-3	‖Bassett, Henry, 26, Belitha-villas, Barnsbury, N.
1891			Bate, William, National Explosives Co., Hayle, Cornwall
1893			Bateman, John, c/o Messrs. J. C. and J. Field, The Marsh, Lambeth, S.E.
1896			Bathurst, Charles, jun., B.A., 3, Stone-buildings, Lincoln's Inn, W.C.
1900			Battle, G. E., Rev., B.A., Totlands, Dane Park, Ramsgate
1896			Bay, L. H., B.Sc. (Lond.), Deacon's School, Peterborough

Date of Election.			
1892			Bayliss, Charles, Ellesmere, Selly Park, near Birmingham
1874			Bayly, F. W., The Royal Mint, Sydney, N.S.W.
1904			Bayly, Harold Goodenough, Moatside, Bedford
1874			‖Bayne, James, 4, Euston Buildings, N.W.
1879			‖Bayne, William Thirlwall, LL.D., Brockhill, Broad Clyst, Exeter
1873			Baynes, James, Ph.D., F.R.M.S., Borough Analyst's Office, Royal-chambers, Scale-lane, Hull
1897			Beadle, A. A., Greenheys, Granville-road, High Barnet
1891	Trans.		Beadle, Clayton, Melrose, Hatherley-crescent, Sidcup
1861			‖Beadnell, Charles Edward, Major, R.A., 3, Templeton-place, Earl's Court, W.
1904			Beadnell, Charles Marsh, Fleet Surgeon, H.M.S. *Erebus*, Portland, Dorset
1867			Beale, William Phipson, K.C., 10, New-court, Carey-street, Lincoln's Inn, W.C. ; and 25, Sheffield-terrace, Kensington, W.
1904			Beam, William, M.A., M.D., Chemical Laboratory, Gordon College, Khartoum, Soudan
1899			Bean, Percy, 17, Dickinson-street, Manchester
1903			Beanes, Alfred Edward, Falcon Works, Wallis-road, Hackney Wick, N.E.
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, G. Russell, D.P.H. (Cantab.), L.R.C.P. (Lond.), M.R.C.S. (Eng.), L.S.A., Warwick House, Upper-street, Islington, N.
1887			Beasley, William C. T., M.A., 10, Stockleigh-road, St. Leonards-on-Sea
1901			Beaven, E. S., 5, Boreham-terrace, Warminster
1890	Trans.		Beck, Charles R., 33, Werter-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, Glendye Cottage, Stevenston, Ayrshire
1901			Bedford, F., B.Sc., 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, P. Phillips, Prof., M.A., D.Sc., Armstrong College of Science, Newcastle-on-Tyne
1901			Bedwell, J. Cardwell, B.Sc., 65, High-street, Colchester
1900			Beesley, F. A., B.Sc., Ecclesbourne, 41, Broomgrove-road, Sheffield
1872	Trans.		‖Beilby, George T., 11, University-gardens, Glasgow
1891			Belbin, T. St. J., Capt., Nortonthorpe Hall, near Huddersfield
1888			Belcher, John Hope, B.A., B.Sc., Municipal Technical Institute, Coventry
1891			‖Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester A., B.A., M.B. (Dublin), Brooklands, Dawlish, S. Devon
1889			Bell, E. Wightman, High Bridge, Spalding

Date of Election.			
1899			Bell, H. P., B.A., 30, Egerton-crescent, S.W.
1865	Trans.		‖Bell, J. Carter, The Cliff, Higher Broughton, Manchester
1863	Trans.	C. 1867-70	Bell, Sir I. Lowthian, Bart., F.R.S., Rounton Grange, Northallerton
1889			‖Bell, Percy Carter, 150, Nassau-street, New York, U.S.A.
1904	Trans.		Bellars, Albert Ernest, B.A. (Cantab.), Magdalene College, Cambridge
1879			Bemrose, Joseph, 56, St. Famille-street, Montreal, Canada
1874			‖Bendix, David, Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1902			Benham, K. B., Dean's Hill, Stafford
1881			‖Benjamin, Marcus, M.A., Ph.D., U.S. National Museum, Washington, D.C., U.S.A.
1904			Benn, R. H. Durward, West Mount, Montreal, Canada
1900			Bennett, A. H., c/o Messrs. Ogston & Moore, 39, Lime-street, E.C.
1904			Bennett, Charles Thomas, 57, Larkhall-rise, Clapham, S.W.
1903			Bennett, Colin Noël, 39, Elgin-mansions, Elgin-avenue, Maida Vale, W.
1900			Bennett, G. L., Rev., M.A., 13, St. Domingo-vale, Everton, Liverpool
1904			Benson, Alick Cole, 33, Perham-road, W. Kensington, W.
1892	Trans.		Bensusan, Arthur J., 9, Carlton-mansions, Holland Park Gardens, W.
1896	Trans.		Bentley, W. H., B.Sc., 6, Woodbine-terrace, Irlam, near Manchester
1890			Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1902	Trans.		Bergtheil, Cyril, Mosheri Factory, Mozufferpore Post Office, Tirhoot, India
1883			‖Beringer, Cornelius.
1900			Beringer, H. R., 11, Dolcoathe-road, Camborne, Cornwall
1882			‖Beringer, John J., A.R.S.M., Pendarves-road, Camborne, Cornwall
1895			Berkeley, The Earl of, Foxcombe, Boar's Hill, Oxford
1890			‖Berncastle, Richard, 22, Aldridge-road-villas, Bayswater, W.
1893			Berridge, Douglas J. P., M.A. (Oxon.), The Laboratory, Malvern College
1882			‖Berry, Edward E., 44, London Wall, E.C.
1899			Berry, R. A., F.I.C., 5, St. Mary's-passage, Cambridge
1891			Berry, Thomas William, Education Office, West Didsbury, near Manchester
1888	Proc.		Berry, William, 7, Hampton-park, Redland, Bristol
1883	Trans.	C. 1898-1900	Bevan, Edward J., 4, New-court, Lincoln's Inn, W.C.
1886			Bevan, John William, Risedale, St. James-crescent, Swansea
1903			Beveridge, Wilfred William Ogilvy, Major, c/o Sir C. R. McGregor, Bart. and Co., 25, Charles-street, S.W.

Date of Election.		
1897		Bhaduri, J. B., M.A., Krishnaghur, Dist. Nadia, Bengal, India
1903		Bhaduri, K., Prof., M.A. (Calcutta), Canning College, Lucknow, India
1903		Bibby, Charles Drake, 69, Queen's-road, Twickenham, Middlesex
1903		Bibby, Robert Gordon, New College, Oxford
1865		‖Bickerdike, W. E., Bryers Croft, Wilpshire, near Blackburn
1902		‖Bickford, Harding, 46, Currie-street, Adelaide, South Australia
1875		Biggart, J. W., Chemical Laboratory, 29, Cathcart-street, Greenock
1872		Biggs, C. H. W., 140, Salisbury-court, Fleet-street, E.C.
1900		Bilimoria, H. N., M.A., B.Sc., Municipal Analyst, Municipal Office, Fort Bombay, India
1881		Bingley, John, Northampton
1900		Binks, F. N., 42, Shortridge-terrace, Jesmond, Newcastle-on-Tyne
1894		Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898		Birkett, Walter, 23, Carline-road, Lincoln
1879		‖Black, A. H., F.R.G.S., St. John's, Wakefield
1902		Black, W. G., A.I.C., 9, Routh-road, Wandsworth Common, S.W.
1886		Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1899	Trans.	Blackman, W. L., Mostyn, Thornlaw-road, West Norwood, S.W.
1903		Blackshaw, George Neville, B.Sc. (Wales), Government School of Agriculture, Elsenburg, Mulder's Vlei, Cape Colony, S. Africa
1899		Blackshaw, J. F., The Midland Dairy Institute, Kingston Fields, Derby
1885		Blades, Charles Mountain, Bay Villa, Chester-road, Northwich, Cheshire
1903		Blair, Herbert, Harton Lodge, Harton, South Shields
1901		Blake, G. S., 9, The Hermitage, Richmond, Surrey
1890	Trans.	Blake, Robert R. F., Chemical Department, Queen's College, Belfast
1890		Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne
1875		‖Blanshard, Charles Thomas, M.A., 3, Seymour-villas, Totnes
1892		Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1902		Blenkinsop, Richard, Garden Wharf, Church-road, Battersea, S.W.
1890		Blenkinsop, W. E. B., c/o Messrs. May and Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1903		Bliss, Henry James Wheeler, B.A., 10, Cornwall-gardens, S.W.
1899		Blofeld, Stuart, Rev., B.A., B.Sc., St. John's College, Battersea, S.W.
1896		‖Blood, Maurice, M.A., 9, Clifton-road, Kingston Hill, Kingston-on-Thames
1891		Bloomer, Frederick John, F.I.C., Penpont, Clydach, R.S.O., Glamorgan

Date of Election.		
1890	Trans.	Blount, Bertram, 76 and 78, York-street, Westminster, S.W.
1888		Bloxam, Arthur G., F.I.C., 105, Birkbeck Bank Chambers, Southampton-buildings, W.C.
1883	Trans.	Bloxam, W. Popplewell, Prof., B.Sc., F.I.C., c/o Messrs. Smith, Fawdon, and Low, Solicitors, 12, Bread-street, Cheapside, E.C.
1903		Bluman, Nicholas John, 10, Amersham-road, New Cross, S.E.
1887		Blundstone, Edwin Richardson, B.A., Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, T. P., M.A., Tower-place, Shrewsbury
1896		Blyde, J. E. A., Merlin House, Broomgrove-road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S., 29, Norfolk-road, N.W.
1892		Blyth, M. Wynter, B.A., B.Sc., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, A., Chemical Works, Stratford, E., and High-standing Loughton, Essex
1902		Boardman, Ernest, B.Sc., 691, St. Helen's-road, Bolton
1899		Boardman, T. H., Christ's Hospital, West Horsham, Sussex
1878		Bodmer, Richard, Analytical Laboratory, 16, Southwark-street, S.E.
1899		Bogert, Marston Taylor, Prof., B.A., Columbia University, New York City, U.S.A.
1899		Bolam, R. A., M.D., 3, Savile-place, Newcastle-on-Tyne
1869	Trans.	‖Bolas, Thomas, 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, E. R., 16, Flanchford-road, Ravenscourt Park, W.
1899		‖Bond, A. E., Princes-chambers, Corporation-street, Birmingham
1883		Bond, Henry C., M.A., 11, Avenue-road, Grantham
1893	Trans.	‖Bone, William Arthur, D.Sc., Ph.D., Owens College, Manchester
1893		Boone, W. T., B.Sc., 6, Sydenham-villas, Cheltenham
1884		Borland, W. D., Beacon Lodge, Green Street Green, near Dartford, Kent
1881		Borns, Henry, Ph.D., 5, Sutton Court-road, Chiswick, W.
1895		‖Borradaile, L. A., Selwyn College, Cambridge
1861		‖Bosanquet, R. H. M., F.R.S., c/o Messrs. Castle, Lamb and Storr, Salisbury-square, Fleet-street, E.C.
1894	Proc.	Bose, Chuni Lal, Prof., 24, Mohendro Bose's-lane, Calcutta
1881		Bostock, G. H., 86, Concord-avenue, Toronto, Canada
1881	Trans.	Bothamley, Charles H., F.I.C., Tangle Wood, Southside, Weston-super-Mare
1887	Trans.	Bott, William Norman, Ph.D., The Vicarage, Sleaford, Lincs.
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1871		Bottomley, James, B.A., D.Sc., 220, Lower Broughton-road, Manchester
1869		‖Bottomley, James T., M.A., F.R.S., F.R.S.E., 13, University Gardens, Glasgow

Date of Election.		
1886		Bottomley, W. Beecroft, Prof., Ph.D., 35, Downside-crescent, Hampstead, N.W.
1894		Boul, William Good, M.A., LL.D., D.C.L., Tideswell Grammar School, near Buxton
1901		Bousfield, E. G. P., St. Swithin's, Hendon, N.W.
1891		Bovell, John R., Dodd's Botanical and Experimental Station, Barbados, West Indies
1865		‖Bowdler, A. C., 20, Bank-terrace, Wellington-street, Blackburn
1903		Bowen, William, A.I.C., Clevedon, Wood End-road, Erdington, Birmingham
1888		Bower, Frank, c/o Messrs. Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, Messrs. Bowes and Sims, 40, Radford-street, Blackley, Manchester
1899		Bowles, B. H., Overdale, Eastwood-road, S. Woodford, N.E.
1896		Bowley, J. J., 64, Redcliffe-gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, Spinningfield, Deansgate, Manchester
1862		Bowman, Frederick H., F.R.A.S., F.L.S., F.G.S., Spinningfield, Deansgate, Manchester
1896		‖Bowman, H. L., M.A., 13, Sheffield-gardens, Kensington, W.
1894	Trans.	Boyd, D. R., Prof., D.Sc., The Hartley University College, Southampton
1901		Boyers, H., 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1903		Bradbury, Samuel, Thornham New-road, Castleton, Lancs.
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Aberfeldy, Southwick, near Brighton
1876		‖Bradley, Nathaniel, Sunnyside, 53, Chapman-street, Hulme, Manchester
1888		Bradshaw, Charles, 169, Spring Vale-road, Sheffield
1881		Braga, John Francis, L.S.A., L.A.H., D.P.H. (Lond. & Cantab.), F.G.S., F.L.S., F.R.G.S., 138, Croydon-road, Anerley, S.E.
1894	Trans.	Brame, J. S. S., Royal Naval College, Greenwich, S.E.
1903		Branch, George Thomas, c/o Mr. Cleghorn, Chemist, Hout-street, Cape Town, South Africa
1904		Brand, Henry Frank, M.A. (Lond.), 13, Clifton-road, Brockley, S.E.
1882		Branson, F. W., 14, Commercial-street, and Wynneholme, Far Headingley, Leeds
1899		Bratby, G. S., 3, Berkeley, Stoke, near Devonport
1882	Trans.	Brauner, B., Ph.D., D.Sc., Spálená ulice 1, Prague, Bohemia
1896		Bray, Daniel, "Tower Hurst," Jefferson-street, Goole, Yorks.
1903		Brennand, Henry John Wolverton, B.A., M.B., Ch.M., 203, Macquarie-street, Sydney, N.S.W.

Date of Election.			
1883			Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901			Bridges, J. S., B.Sc., 45, Thistlethwaite-road, Clapton, N.E.
1904	Trans.		Bridgett, Robert Currie, M.A., B.Sc. (St. Andrews), 32, Queen Anne-street, Dunfermline, Fifeshire, N.B.
1897			Brierley, James, 18 and 19, French-street, Southampton
1890	Trans.		Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston
1898			Brierley, Joseph, B.Sc., Ashton-road, Failsworth, Manchester
1893	Proc.		Briggs, John Frederick, 12, Salisbury-road, Maidstone
1883			‖Briggs, T. Lynton, 188, Central-avenue, Flushing, L.I., U.S.A.
1884			‖Briggs, William, M.A., LL.D., D.C.L., 12, Queen Anne-terrace, Cambridge
1902			Brincker, John Augustus Herman, B.A. (Cantab.), M.B., B.S. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), A.I.C., The Borough Hospital, Croydon
1898	Trans.		Brittain, C. E., B.Sc., Grammar School, Normanton, Yorks.
1900			Britten, F. C., B.A., Odiham School, Odiham, Hants.
1889			Broadbent, Harry, A.I.C., 187, Hyde Park-road, Leeds
1879			‖Broadbent, John J., 14, Cross-street, Exchange, Manchester
1883			Brock, John, J.P., Gwern-Tyno, Colwyn Bay, N. Wales
1893			‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth
1904			Broderick, George Edward Peach, B.Sc. (Lond.), Bryn Llewelyn, Lampeter, S. Wales
1884			Brodie, Sir Benjamin V. S., Bart., Brockham Warren, Betchworth, R.S.O., Surrey
1898			Brooke, Arthur, M.A., Holderness College, Withernsea, East Yorks.
1900			Brooke, C. B., Colne House, Brantham, near Manningtree, Essex
1900			Brooke, J. R., F.I.C., 20, Cullum-street, E.C.
1898			Brooks, C. J., London-road, Thetford
1886	Trans.		‖Brothers, H. E., B.Sc., F.I.C., 117, Summerfield-crescent, Edgbaston, Birmingham
1884		C. 1895-8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., F.G.S., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, Prof., M.Sc., West Heath House, Northfield, Worcs.
1867	Trans.	C. 1872-4 V.P. 81-4 90-1 P. 91-3	Brown, Alexander Crum, Prof., M.A., M.D., D.Sc., F.R.S., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, c/o Messrs. W. Ropes and Co., St. Petersburg, Russia
1873	Trans.	C. 1881-3	‖Brown, Frederic Douglas, Prof., B.Sc., University College, Auckland, New Zealand

Date of Election.			
1884			Brown, F. W., Ingleside, 39, Loveday-road, West Ealing, W.
1892			Brown, George Fitz-, A.R.S.M., F.I.C., The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, G. Noël, 24, Irwell-chambers, Liverpool
1880			Brown, Henry, Benskin's Brewery, Watford, Herts.
1871	Trans.	C. 1883-7 V.P. 94-7 1904- T. 1903-04	†Brown, Horace T., LL.D., F.R.S., 52, Nevern-square, Kensington, W.
1867	Trans.		‖Brown, James Campbell, Prof., D.Sc., 8, Abercromby-square, Liverpool
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1897			Brown, J. H., City Gas Offices, 6, George-street, Nottingham
1892			Brown, Reginald B., 11, Circular-road, Withington, Manchester
1884			Brown, William George, Prof., Ph.D., University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, C. E., B.Sc., Christ's Hospital, West Horsham, Sussex
1893			Browne, Frank, 16, Tayfen-road, Bury St. Edmunds
1873			Brownen, George, Grove-road East, Avon Park, Christchurch, Hants.
1899	Trans.		Browning, K. C., B.A., The Limes, Longlands, Dawlish, S. Devon
1890			Brownsword, Frank, M.Sc., Bryn Derwen, Old Colwyn, N. Wales
1902			Bruce, Alexander, B.Sc., The Laboratory, Hyde Park Corner, Colombo, Ceylon
1894	Trans.		Bruce, James, B.Sc., F.I.C., The Technical College, Huddersfield
1895			Bruckmann, G. T., B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1904			Brühl, Paul, Engineering College, Sibpur, near Calcutta, India
1899	Trans.		‖Brünnich, J. C., Dept. of Agriculture, Brisbane, Queensland
1893	Trans.		‖Brunton, John Dixon, Wire Mill, Musselburgh, near Edinburgh
1903			Bryant, Vernon Seymour, B.A. (Cantab.), Rugby Cottage, Beeches-road, West Bromwich
1877	Trans.		‖Buch, C. von, M.A. (Oxon.), 36, Great Marylebone-street, W.
1877	Trans.		Buchanan, J. Y., F.R.S., 26, Norfolk-street, Park-lane, W.
1876			‖Buckmaster, C. A., 16, Heathfield-road, Mill Hill Park, Acton, W.
1902			Bucknell, Edwin Thomas Holman, 19, Reservoir-road, Edgbaston, Birmingham
1852	Trans.	C. 1855-8, 65-6	‖Buckton, G. B., F.R.S., Weycombe, Haslemere, Surrey
1878			Budden, E. Russell, Park View, Eversleigh-road, Finchley, N.
1904			Buggé, Erasmus Robert, 327, Grove Green-road, Leytonstone, E.
1898	Trans.		Bull, B. S., M.A., B.Sc., Ph.D., Greylands, 104, Humber-road, Blackheath, S.E.
1842			Bullock, John Lloyd, 3, Hanover-street, Hanover-square, W.

† Longstaff Medallist, 1894.

Date of Election.		
1901		Bult, H. J., 18, Billiter-street, E.C.
1890		Bunting, H. H., c/o Peruvian Corporation, Ltd., Lima, Peru
1896		Burbridge, J. K., The Orchard, Philip-lane, Tottenham, N.
1891		Burford, Samuel Francis, The Firs, Kirby Muxloe, near Leicester
1898		Burge, C. H., Iddesleigh, Crescent-road, Kingston Hill, S.W.
1894	Trans.	Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.
1901		Burgess, P. J., M.A., Government Analyst, Singapore
1884		Burgess, William Thomas, F.I.C., 46, Portland-road, Holland Park, W.
1903		Burghard, William Godsell, 180, High Holborn, W.C.
1884		‖Burland, Jeffrey H., 824, Sherbrooke-street, Montreal, Canada
1897		Burland, R. O., J.P., Poolstock House, Wigan
1894		Burman, G. W., Cwmfelin Steel and Tin Plate Co., Ltd., Swansea
1849	Trans.	Burnard, Charles F., Plymouth Chemical Works, and Chatsworth Lodge, Compton Gifford, Plymouth
1885	Trans.	Burnett, Joseph Fearon, 8, River View, Ashton, Preston
1901		‖Burnett, T. R., B.Sc., Ph.D., 7, Harbord-road, Overstrand, Cromer
1893		Burnham, John Charles, Cordite Factory, Wellington, Nilgir Hills, India
1882	Trans.	Burrell, B. Arthur, 8, Springfield Mount, Leeds
1902	Trans.	Burrows, Harry., Ph.D., A.R.C.S., F.I.C., The Green, Southgate, N.
1901	Trans	Burrows, M. W., M.Sc., Dunkirk, Devizes
1900		Burton, William, Clifton Junction, near Manchester
1891		Burton, W., 47, Humberstone-road, Cambridge
1903		Bury, Ernest, M.Sc., Brackley Coke Works, Little Hulton, near Bolton, Lancs.
1894		Bush, William, The Retreat, Clytha Park, Newport, Mon.
1890		Butcher, William J., Queen Elizabeth's Grammar School, Ashbourne, Derbyshire
1895		Butler, D. Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston, Birmingham
1894		Buttemer, Robert William, St. Mary's, Godalming
1875		Butterfield, J. C., 79, Endlesham-road, Balham, S.W.
1892		Butterfield, W. J. Atkinson, M.A., Overdale, Bletchingley, Surrey
1902		Buxy, Tarit Kanti, Prof., Government College, Jubbulpur, C.P., India
1888		Byrn, G. A., 97, Pitt-street, Sydney, N.S.W.
1903		Bywaters, Hubert William, Ph.D. (Würzburg), A.R.C.S., A.I.C., 11, King-street, Regent-street, W.

Date of Election.		
1903		Cadman, William Henry, B.Sc. (Wales), Sandymount Castle, Dublin
1893		‖Cahill, Robert S., Sunnyside, Heckmondwike
1894	Trans.	‖Cain, John Cannell, D.Sc. (Vict. and Tübingen), 28, Pembury-road, Lower Clapton, N.E.
1898	Proc.	Caldecott, W. A., B.A., Box 67, Johannesburg, Transvaal, South Africa
1891		‖Calder, William A. S., The Hollies, South-road, Smethwick, Birmingham
1884		Caley, Edward J., Chapel Field Works, Norwich
1896		Caley, John, Premier Oil Extracting Co., Stoneferry, Hull
1903	Trans.	Calvert, Harry Thornton, Ph.D. (Leipzig), B.Sc. (Vict.), West Riding of Yorkshire Rivers Board, Wakefield, Yorks.
1871		Calvert, J. H., Avenham Tower, Preston
1900		Calvert, S., M.A., B.Sc., State University, Columbia, Missouri, U.S.A.
1894		Cameron, Alexander, 59, Lexham-gardens, Kensington, W.
1875		Cameron, J. Macdonald, F.G.S., F.I.C., Castle Hill, Tain, N.B.
1893		Cameron, James, Ingleby, 70, Old Chester-road, Wood Hey, Rock Ferry, Birkenhead
1892		Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burma
1888	Trans.	Campbell, J. Morrow, B.Sc., F.R.G.S., Blenheim-gardens, Wallington, Surrey
1903		Campbell, Thomas, 38, Eastbourne-street, Liverpool
1898		Campion, Alfred, Cooper's Hill, Englefield Green, Surrey
1896		Candy, Hugh, B.A., B.Sc., The College, London Hospital, E.
1884		Cannon, Matthew, 25, Stormont-road, Clapham Common, S.W.
1898		Cannon, M. J., 16 and 17, Devonshire-square, Bishopsgate-street, E.C.
1900		Cantin, A., Prof., Vacoas, Mauritius
1888		Carey, Alfred Edward, M.I.C.E., F.R.G.S., F.G.S., Dominion House, 110, Fenchurch-street, E.C.
1892	Trans.	Carey, Arthur, B.Sc., 1, Grassendale-road, Grassendale, near Liverpool
1902		Carmichael, Thomas Burnell, Parton, Whitehaven
1889		Carmody, P., Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad
1899	Trans.	‖Carpenter, H. C. H., M.A., Ph.D, National Physical Laboratory, Bushy House, Teddington, S.W.
1875		‖Carpenter, H. S., F.I.C., Beckington House, Weighton-road, Anerley, S.E.
1899		Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.

Date of Election.			
1895	Trans.		Carr, Francis Howard, F.I.C., Kelvin, Church-avenue, Sidcup, Kent
1903			Carrier, Albert James, B.Sc. (Lond.), H.M. Patent Office, Chancery-lane, W.C.
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks.
1902			Carrodus, Fred., Glen Fern Tower, Lansdowne-road, Wimbledon, S.W.
1882			‖Carruthers, Robert, 90, High-street, Dumfries
1893			Carswell, Thomas Retson, 50, Sandmere-road, Clapham, S.W.
1864		C. 1878-82, 84-8	‖Carteighe, Michael, 180, New Bond-street, W.
1901	Trans.		Carter, W., Sewage Works, Bury
1867			‖Carulla, F. J. R., 84, Argyle-terrace, Rose Hill, Derby
1895			Case, T. B., B.A., 108, James's-street, Dublin
1879			‖Cassal, Charles Edward, Lieut.-Col., Town Hall, Kensington, W.
1903			Castell-Evans, John, 141, Ferme Park-road, Crouch End, N.
1902			Catchpole, F. E., 17, Sprules-road, Brockley, S.E.
1894			Catherall, Ezra, Heathmere, Albany-road, Harborne, Birmingham
1903			‖Caudwell, Ben, B.A. (Lond.), 28, Wigfull-road, Sheffield
1898	Trans.		Caven, R. M., D.Sc., F.I.C., University College, Nottingham
1902			Challen, Matthew Bradbury, School of Mines, Daylesford, Victoria, Australia
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, A. G., Rugby
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			‖Chance, Alexander M., Lawnside, Edgbaston
1902			‖Chance, Kenneth Macomb, B.A., The Bath Club, Dover-street, W.
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1872			Chandler, William H., Prof., Chem. Dept., Lehigh University, South Bethlehem, Pa., U.S.A.
1884			Chantrell, P. S., c/o Messrs. Tate & Sons, Ltd., Love-lane Sugar Refinery, Liverpool
1889			‖Chaplin, Edward Mitchell, Ph.D., 60, Westgate, Wakefield
1886	Trans.		Chapman, Alfred Chaston, F.I.C., 8, Duke-street, Aldgate, E.C.
1895			Chapman, Arthur Jenner, 14, Baronsmere-road, East Finchley, N.
1899	Trans.		Chapman, David Leonard, B.A., 10, Parsonage-road, Withington, Manchester
1900	Trans.		Chapman, E. M., Cairnsmore, Manor-road, Scarborough
1868			Chapman, Edward, Hill End, Mottram, Manchester
1891			Charles, Rhys Pendrill, Plâs Newydd, Neath
1900			Chater, A. B., 65, Queen-street, Brisbane, Queensland
1894	Trans.	C. 1900-03	Chattaway, Frederick Daniel, M.A., D.Sc., Ph.D., Longfield, Kenton-road, Harrow

Date of Election.			
1895			Cheadle, Walter W., B.A., 36, London-road, Grays, Essex
1899			Cheater, T. J., B.Sc , 3, The Mansions, Star and Garter, Putney S.W.
1900			Cheesright, J. H., B.Sc., 110, Balmoral-avenue, Gateshead-on-Tyne
1890			Cheetham, Thomas Arthur, 2, Doune-quadrant, Kelvinside North, Glasgow
1887			Chenhall, J. W., M.I.C.E., Dart-villas, Totnes, Devon
1878			Cheshire, H. F., Woodside, Shornden, St. Leonards-on-Sea
1882			‖Chester, Edward D.
1897	Trans.		Chikashigé, Masumi, B.Sc., Imperial University, Kyōtō, Japan
1871			Childs, Christopher, M.D. (Oxon.), 10, Manchester-square, W.
1897			Cholerton, A. F., Beech Leigh, Harboro'-road, Leicester
1891	Trans.		‖Chorley, John C., Bewsey, Oxford-road, Birkdale
1885			Christopher, G., Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William J., 7, West George-street, Glasgow ; and Shawfield Works, Rutherglen, near Glasgow
1856	Trans.	{C. 1876-80, 87-90}	Church, Arthur Herbert, M.A., D.Sc., F.R.S., Shelsley, Kew, Surrey
1903			Clacher, William, Bryantwood, Auckland-road, Ilford, Essex
1888	Trans.		Claisen, Ludwig, Prof., Ph.D. Chemisches Institut, Brunswickerstrasse 2, Kiel, Germany
1901	Trans.		Clark, Ernest, B.Sc., Royal Technical Institute, Salford, and 16, Havelock-street, Sheffield
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1876	Trans.		Clark, John, Ph.D., 138, Bath-street, Glasgow
1897			Clarkson, Alexander, Grange-terrace, Stewarton, R.S.O., Ayrshire
1902			Claudet, Arthur Crozier, A.R.S.M., 27, Daleham-gardens, Hampstead, N.W.
1852	Trans.		Claudet, Frederic, 6, Coleman-street, E.C.
1882	Proc.		Clayton, Edwy Godwin, F.I.C., 32, Holborn-viaduct, E.C.
1904			Clayton, Ellis, 1, Hall Royd, Shipley, Yorks.
1893			Clayton, George, Northern College of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, 3 and 5, Concert-street, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, W., Sewage Outfall Works, Wolverhampton
1878			Cloud, Thomas Charles, A.R.S.M., Coronation House, 4, Lloyds-avenue, Fenchurch-street, E.C.
1902			Clough, William Thomas, A.R.C.S., 33, Honeybrook-road, Clapham Park, S.W.

Date of Election.			
1869	Trans.	C. 1885-90, 99-03	‖Clowes, Frank, Prof., D.Sc., 40, Craven-street, Strand, W.C.
1902			Clowes, George Henry Alexander, Ph.D., Gratwick Research Laboratory, University of Buffalo, U.S.A.
1897			Clutterbuck, M. C., B.Sc., Ph.D., 61, Beaconsfield-villas, Brighton
1887			Coates, William Henry, M.A., M.B., M.R.C.S., L.R.C.P., L.S.A., 7, Albion-street, Hull
1896			Cobb, W. W., M.A., Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A., Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D., 115-119, W. 68th-street, New York, U.S.A.
1880			‖Cockburn, Arthur Cecil, Otley Grange, Otley, near Ipswich
1895	Trans.		Cockburn, G. B., B.A., B.Sc., Lingdale Lodge, Birkenhead
1901			Cockburn, T. K., 26, Elm-street, Whiteinch, Glasgow
1892			Cockerill, T., The Technical College, Colombo, Ceylon
1893			Cocking, Allan Thomas, The Grove, Stanford-le-Hope, Essex
1888			Cocking, Lewis Smith, Wharf Mills, Apsley, Huddersfield
1903			Cockle, Charles, 14, Alswitha-terrace, King Alfred Place, Winchester
1901			Coddington, E., M.A., 131, St. James's-road, Upper Tooting, S.W.
1903			Codling, Arthur John, 5, Tavistock-square, W.C.
1881			‖Coffin, Walter H., 26, Belgrave-road, Eccleston-square, S.W., and Kew Gardens, Surrey
1885	Trans.		Cohen, Julius B., Prof., Ph.D., The University, Leeds
1901			‖Cohen, R.W., B.A., 11, Hyde Park-terrace, W.
1900			Cole, O. J., B.A., Park-road, Wivenhoe, Essex
1891	Trans.		Colefax, Arthur, M.A., Ph.D., 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Collenette, Adolphus, Brooklyn, Fort-road, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcs.
1881			Collett, John Marton, Hillfield, Gloucester
1885	Trans.	C. 1889-94, 1900-1	‖Collie, J. Norman, Prof., Ph.D., F.R.S., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc., 4, Wyndham-road, Edgbaston, Birmingham
1892			‖Collins, Hugh Brown, B.Sc., Auchinbothie, Kilmalcolm, N.B.
1890			Collins, Sydney Hoare, Armstrong College of Science, Newcastle-on-Tyne
1888			Collins, W. Hepworth, c/o Messrs. Th. Cook et Fils, 1, Place de l'Opera, Paris
1887	Trans.		‖Colman, Harold G., Ph.D., Elmside, Worcester Park, Surrey

Date of Election.		
1890		Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900		Comber, A. W., Ramabhadrapuram Post Office, Vizagapatam District, India
1892		‖Comyns, Frank, M.A., The Lindens, Newbury, Berks.
1891		Congdon, Ernest A., Prof., The Drexel Institute of Art, Science, and Industry, Chestnut-street, Philadelphia, Penn., U.S.A.
1899		Cornah, James, B.Sc., F.I.C., 31, Rudall-crescent, Hampstead, N.W.
1899		Connell, R. D., Dzansoul Copper Works, c/o Messrs. F. H. Mattierich & Co., Baloum, South Russia
1875		Connor, Charles C., B.A.
1883		‖Conrad, Edwin C., Manor House, Chalk, Gravesend
1902		Cook, Arthur James, 167, Richmond-road, Hackney, N.E.
1875	Trans.	‖Cook, E. H., D.Sc. (Lond.), The Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895		Cook, Herbert W., B.Sc., c/o The Turf Club, Cairo, Egypt
1890		Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888		Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889		Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.
1897		‖Cooper, A. J. Bullen, Grimston Lawn, Haven Green, Ealing, W.
1892		Cooper, Arthur James, B.A., B.Sc., Brewood School, Staffs.
1888		Cooper, Astley, Clifford, near Boston Spa, R.S.O., Yorks.
1898		Cooper, John Burdon-, Glenartney, Poole-road, Bournemouth
1900		Cooper, W. F., B.A., 6, Hobson-street, Cambridge
1891		Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897		Cooper, William Ransom, M.A., B.Sc., 113, Tulse Hill, S.W.
1894	Proc.	Coote, A. H., Garwood, 36, Humber-road, Blackheath, S.E.
1899	Trans.	Cope, Frank, 92, Bradford-road, Dewsbury
1890		‖Coppock, J. B., B.Sc., Science School, Lansdown, Stroud
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts.
1901	Trans.	Cormack, William, 3, Westfield-place, Eskbank, N.B.
1888		‖Cornish, Vaughan, D.Sc., 72, Princes-square, W.
1890		Corrie, David, Nobel's Explosives Company, West Quarter Factory, Polmont Station, N.B.
1893	Trans.	Coste, John Henry, 206, Amhurst-road, Hackney, N.E.
1892		‖Couldrey, Henry, H.M.'s Mint, Bombay, India
1900		Courtman, E.O., Denford House, Atkins-road, Clapham Park, S.W.
1903		‖Cousins, Francis George, 16, Old Elvet, Durham
1901	Trans.	Cousins, H. H., M.A., Government Laboratory, Kingston, Jamaica
1885		Cousins, William J., 17, Temple-chambers, Temple-avenue, E.C.

Date of Election.			
1886	Trans.		‖Coutts, Francis J. H., M.D., D.P.H. (Vict.), 22, Read's-avenue, Blackpool
1898			Cowburn, A. W., 29, Princess-street, Manchester
1882			‖Cowie, Thomas R., Merchant-street, Rangoon, Burma
1898			Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873			Cownley, Alfred J., 225, Barry-road, Dulwich, S.E.
1904			Cowper, Alfred Denys, 121, Castellain-mansions, Maida Vale, W.
1888			Cowper, Joseph, 50, King-street, Penrith
1886			Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898			Cox, F. Hudson, 46, St. James'-road, Brixton, S.W.
1873			Cox, Samuel Herbert, 13, St. Helen's-place, London, E.C.
1903			Coyle, Benjamin Claxton, City Laboratory, 17, Castle-street, Dublin
1901			Crabtree, A., 9, Bigg Market, Newcastle-on-Tyne
1870	Trans.		Crafts, J. M., Prof., 59, Marlborough-street, Boston, Mass., U.S.A.
1892	Trans.		Craig, Andrew William, College of Pharmacy, 360, Swanston-street, Melbourne, Victoria
1875			‖Crampton, George.
1897			Cranfield, William, The Higher Grade Board School, Halifax
1897			Creasey, C. H., 6, Park-terrace, Llandaff Fields, Cardiff
1875			Cresswell, Charles Gerard, Ermyngarth, Ashtead, Epsom
1887			‖Cribb, Cecil Howard, B.Sc., 136, Shaftesbury-avenue, W.
1878			Criper, William Risdon, Chemical Works, Konnagar, Calcutta
1895			Crocker, C., Norman House, St. Peter's-road, Cockett, Swansea
1902	Trans.		Crocker, James Codrington, B.A., South Western Polytechnic, Manresa-road, Chelsea, S.W.
1901			Crocker, W. S., 39, Arnold-street, Princes Park, Liverpool
1897	Trans.		Crofts, J. Murray, M.A., B.Sc., The College, Barnato Park, Johannesburg, South Africa
1886	Trans.		‖Crompton, Holland, Binfield, Chester-road, Northwood, Middlesex
1902			Crookes, Henry, 109, Ladbroke-grove, Notting Hill, W.
1901			Crookes, S. I., Rose Villa, Clay Cross, near Chesterfield
1857	Trans.	C. 1866-70 V.P. 76-9, 85-7 P. 87-9	‖Crookes, Sir William, D.Sc., F.R.S., 7, Kensington Park-gardens, W., and Athenæum Club, Pall Mall, S.W.
1879	Trans.	C. 1890-1 93-5	Cross, Charles Frederick, 4, New-court, Lincoln's Inn, W.C.
1890	Trans.	C. 1901-2	‖Crossley, Arthur William, Prof., D.Sc. (Vict.), Ph.D. (Würzburg), Pharmaceutical Society, 17, Bloomsbury-square, W.C.
1901			Crossley, F., Duchy Bank, Seedley-road, Pendleton, Manchester
1896			Crossman, C. M., B.Sc., 10, Oseney-crescent, Camden-road, N.W.
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1899			Crouch, W. S., 265, Glossop-road, Sheffield
1880	Trans.		Crow, John Kent, D.Sc., Tressillian, Ulundi-road, Blackheath, S.E.

Date of Election.		
1887		‖Crowther, Horace Woodward, The Beeches, West Bromwich
1895		Croysdale, John, Whitley Bridge, R.S.O., Yorks.
1884		Crumbie, William D., 146, Washington-street, East Orange, New Jersey, U.S.A.
1887	Trans.	Cundall, J. Tudor, B.Sc., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1899	Trans.	Cunnington, A. V., c/o Messrs. Brunner, Mond & Co., Northwich
1875		Curphey, William Salvador, Borva, Lenzie, N.B.
1900		Cussons, John, B.Sc., Kingswood College, Grahamstown, South Africa
1881		‖Custance, John D., Prof., Park-road, Cowes, Isle of Wight
1895		Cuthbertson, L. M. G., 89, Lordship Park, N.
1894		Dains, Herbert H., F.I.C., 27, Inderwick-road, Stroud Green, N.
1901	Trans.	Dakin, Henry Drysdale, B.Sc. (Vict.), A.I.C., The Lister Institute of Preventive Medicine, Chelsea, S.W.
1901		Daniel, G. H., B.Sc., 6, Benson-street, Ulverston
1897		Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal
1887		Daniell, L. C., Royal Standard Brewery, Tamworth, N.S.W.
1902		Daniels, James Ward, Westwood, Medomsley, R.S.O., Durham
1850		‖Danson, Joseph.
1892		Darbishire, Francis V., B.A., Ph.D., Hulme Hall, Plymouth-grove, Manchester
1852		Darby, Stephen, Cookham Dean, Berks.
1899		Darling, C. R., A.I.C., Bryniach, Brent-road, Plumstead, Kent
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	‖Darling, William Howarth, 126, Oxford-street, Manchester
1893		Davey, George, c/o The Mount Boppy Gold Mining Co., Ltd., Boppy Mount, N.S.W.
1875		‖Davey, G. W., Bleak House, Barking Creek, Essex
1897		Davidge, H. N., 1, Rydal-gardens, Rydal-road, Streatham, S.W.
1900		Davidson, Alexander, 2, Hamilton-park-terrace, Hillhead, Glasgow
1901		Davidson, J. H., B.Sc., Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell Green, Halifax
1899	Trans.	Davidson, William Brown, M.A., D.Sc., Ph.D., 3, Vernham-road, Plumstead, Kent
1866	Trans.	‖Davies, Arthur E., Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, The Laboratory, 28, Chapel-street, Liverpool
1896		Davies, L. J., Bute-chambers, Bute-road, Cardiff
1894		Davies, S. H., Rowntree's Cocoa Works, York
1900		Davis, A. C., 2, Downing-grove, Cambridge
1902		Davis, Charles Benson, c/o Dr. Francis Wyatt, S.W.-corner, 23rd-street, and 9th-avenue, New York, U.S.A.

Date of Election.			
1901			Davis, Francis, Whitwell-place, Elland, Yorks.
1902			Davis, Frederick, B.Sc., 29, Bridgemont, Whaley Bridge, near Stockport
1902			Davis, Henry Wilson, Farleigh, Crescent-road, Kingston Hill, S.W.
1857			‖Davis, J. Frederick, F.G.S., Archbrook, Budleigh-Salterton, Devon
1872	Trans.		‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876			Davis, Thomas Sebastian, 199, South Lambeth-road, S.W.
1897	Trans.		Davis, W. A., B.Sc., Central Technical College, South Kensington, S.W.
1876			‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1900			Davison, Thomas C., 49, Victoria-road, New Swindon, Wilts.
1895			Daw, Frederic Weldon, A.R.C.S., Eureka-place, Ebbw Vale, Mon.
1900	Trans.		Dawson, H. M., B.Sc., Ph.D., The University, Leeds, and North-terrace, Bramley, Leeds
1899			Dawson, H. Royal, c/o Messrs. Peyton and Son, Lister-street, Birmingham
1890			Day, Charles Edwin, B.Sc., 16, Hamlet-gardens, Ravenscourt Park, W.
1881	Trans.		‖Day, T. Cuthbert, 36, Hillside-crescent, Edinburgh
1901	Trans.		Dean, G., M.A., 4, Empress-avenue, Ilford, E.
1886			Deane, Leopold M., Davington House, and The Cotton Powder Co., Ltd., Faversham
1859	Trans.	{ V.P. 1871-4 }	Debus, Heinrich, Prof., Ph.D., F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1899			‖De Castro, J. P., M.A., Laboratory and Assay Office, Effingham House, Arundel-street, Strand, W.C.
1885	Trans.		Dechan, Martin, Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, Hollydene, Tenison-avenue, Cambridge
1904			Deeks, William Thomas, High-street, Shanklin, Isle of Wight
1869	Trans.		‖Deering, W. H., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël F., Blairmont, Berbice, British Guiana.
1901			De la Rue, E. A., B.A., 81, Westbourne-terrace, W.
1892			Denison, Joseph R., 18, Duckworth-lane, Bradford
1890			Dennant, John, F.G.S., Orwell, Stanhope-grove, Camberwell, Victoria, Australia
1902			Dennis, W., 170, Albert-road, Jarrow-on-Tyne
1904			Derwent, Ernest, 915, Offnere-street, Portsmouth, Ohio, U.S.A.
1903	Trans.		Desch, Cecil Henry, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Instow, Mount Pleasant-road, South Tottenham, N.
1897			Deverell, L. C., Straits Trading Co., Singapore, Straits Settlements

Date of Election.			
1870	Trans.	C. 1874-7 V.P. 80-3 86-8, 96-7 P. 97-9	‖Dewar, Sir James, M.A., LL.D., D.Sc., F.R.S., Royal Institution, Albemarle-street, W.
1900			Dewhirst, J. A., 36, Southfield-square, Bradford
1886			‖Dey, Preo Lall, 4, Beadon-street, Calcutta, India
1880			Dibdin, W. J., F.I.C., Mayfield, Grange-road, Sutton, Surrey
1872			Dickinson, Arthur John, F.I.C., Truro Villa, 57, Lewisham High-road, S.E.
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1887			Dickson, T. Arthur, Estate Office, Overstone Park, Northampton
1860	Trans.	C. 1873-4 V.P. 1900-03	‖Divers, Edward, Prof., M.D., D.Sc., F.R.S., 3, Canning-place, Palace Gate, W.
1903			Divine, Thomas, M.B., C.M., Public Health Department, Huddersfield
1897			Dixon, Andrew James, Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900–	Dixon, Augustus Edward, Prof., M.D., Queen's College, Cork
1896	Trans.		Dixon, Frank, B.Sc., The Institute, Lydney, Gloucester
1894	Proc.		‖Dixon, George, M.A., Trinity College, Cambridge, and St. Bees, R.S.O., Cumberland
1876	Trans.	C. 1892-6 V.P. 1904-	‖Dixon, Harold Baily, Prof., M.A., F.R.S., Owens College, Manchester
1893			Dixon, Harry W., Clarence Iron and Steel Works, Leeds
1901			Dixon, John K. S., c/o Messrs. H. Richardson & Co., Chemical Manure Manufacturers, York
1890			Dixon, William, 4, Park-place East, Sunderland
1895			Dixon, William, 102, Spring-street, Bury
1862			Dixon, William Adam, 97, Pitt-street, Sydney, N.S.W.
1882	Trans.	C. 1901-	Dobbie, James Johnstone, Prof., M.A., D.Sc., F.R.S., Museum of Science and Art, Edinburgh
1887	Trans.		Dobbin, Leonard, Ph.D., Chemical Laboratory, New University-buildings, Edinburgh
1902			Dobson, Henry Arthur, Southern Cross S.S. Composition Co., 9, Bridge-street, Sydney, N.S.W.
1898			Dodd, F. R., Victoria-villas, 139, Burscough-street, Ormskirk
1901			Dodd, R., 28, Sibella-road, Clapham, S.W.
1888			‖Dodd, William Henry, 8, Kempson-road, Walham Green, S.W.
1886			Dodd, W. Ralph, "Frederwen," Village-road, Enfield, N.
1892			Dodds, George Price, 23, Greenbank-road, Darlington
1897	Proc.		Dodgson, J. W., B.Sc., University College, Reading
1894	Proc.		Doherty, W. M., Government Laboratory, Sydney, N.S.W.
1900			Donald, William, Saltcoats, Ayrshire
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham

Date of Election.		
1901	Trans.	Donnan, F. G., Prof., M.A., Ph.D., University Chemical Laboratory, Brownlow-street, Liverpool
1897	Trans.	Dootson, F. W., M.A. (Cantab.), D.Sc. (Dublin), University Chemical Laboratory, Cambridge
1886	Trans.	Doran, Robert Elliott, Chemical Dept., Queen's College, Cork
1902		Dorée, C., M.A., B.Sc., Seafield Park College, Fareham, Hants.
1900		Dougall, J. D., Senhouse-street, Maryport, Cumberland
1888		Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1884		Down, Frederick J., Glengariff, Milton-road, Harpenden, Herts.
1899		Doyle, Frederick, 28, Glenfield-road, Leicester
1899		Drake, F. A., B.Sc., 24, Cavendish-square, Hull
1884		Draper, Henry Carter, 68, Wodehouse-terrace, North Circular-road, Dublin
1891		Dreaper, W. Porter, Clifton Villa, Coggeshall-road, Braintree, Essex
1893		Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1903		Drought, James Justinian, Molo, *viâ* Mombasa, British East Africa, and The New Club, Johannesburg
1895		Druce, Edric, County Agricultural Institute, Ridgmont, Aspley Guise, R.S.O.
1904	Trans.	Drugman, Julien, Ph.D. (Bonn), Owen's College, Manchester
1901		Dubois, R., B.Sc., Viticultural College, Rutherglen, Victoria
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1901		Duckworth, W. H., Blackburn Corporation Sewage Works, Samlesbury, near Preston
1900		Dudderidge, F. R., 45, Sydney-grove, Newcastle-on-Tyne
1898		Dudley, C. B., Ph.D., Drawer 334, Altoona, Penn., U.S.A.
1890		‖Dudley, William L., Prof., Vanderbilt University, Nashville Tennessee, U.S.A.
1892		Duffield, Walter William, 4, Cortayne-road, Hurlingham, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A., D.Sc., Holmesdale, The Avenue, Cambridge
1897		Dufty, Lawrence, 23, Broomhall-place, Sheffield
1884		Duggan, T. R., 17, Foyle-road, Blackheath, S.E.
1889		Duisberg, Dr. Carl, Elberfeld, Germany
1889		‖Dukes, Thomas William, P.O. Box 10, Vryheid, South Africa
1881		Duncan, Arthur W., 1, Trafalgar-road, Higher Bentcliffe Pendleton, Manchester
1894	Proc.	‖Duncan, Cecil Cooke, The Shire Hall, Worcester
1863		Duncan, James, 52, Shakespeare-street, Hove, Sussex
1891		Duncan, William, The Laboratory, 65, Bath-row, Edgbaston, Birmingham

Date of Election.			
1896			Duncan, William, Royal Dispensary, 21, W. Richmond-street, Edinburgh
1894	Proc.		‖Dunn, Frederic, 193, Collins-street, Melbourne, Australia
1882			Dunn, J. T., D.Sc., 10, Dean-street, Newcastle-on-Tyne
1893			Dunnington, Francis P., University of Virginia, Charlottesville, U.S.A.
1899			Dunscombe, F. C., c/o Electric Reduction Co., Buckingham, Quebec, Canada
1901	Trans.		Dunstan, A. E., B.Sc., Owen's School, Islington, E.C.
1885			Dunstan, Malcolm James Rowley, M.A. (Oxon.), The College, Wye, Kent
1879	Trans.	C. 1888-91 S. 93-1903 V.P. 1903-	‖Dunstan, Wyndham R., Prof., M.A., LL.D., F.R.S., Imperial Institute, S.W.
1860	Trans.	C. 1871-5	Dupré, August, M.A., Ph.D., F.R.S., 2, Edinburgh Mansions, Howick-place, S.W.
1896			Durant, H. T., The Rhodesia Gold Fields, Ltd., Bulawayo, Matabeleland, South Africa
1871			‖Durham, Henry, City of London School, Victoria Embankment, E.C.
1883	Proc.		Durrant, Reginald G., M.A., The College, Marlborough, Wilts.
1892			Duxbury, Thomas, 17, Grosvenor-chambers, Deansgate, Manchester
1875	Trans.	C. 1893-7 1904-	‖Dyer, Bernard, D.Sc. (Lond.), 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, 78, Duke-street, Chelmsford
1885	Trans.		Dyson, Gibson, Ph.D., Venn Farm, Marden, Hereford
1883	Trans.		‖Dyson, Septimus, 8, Belmont-avenue, Harrogate
1876			‖Earp, Francis S., Ph.D., F.I.C., 72, Addis-street, Kalgoorlie, West Australia
1889	Trans.		Easterfield, Thomas Hill, Prof., M.A., Ph.D., The Victoria College, Wellington, New Zealand
1891			Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.
1881			Eastick, John J., Millaquin Refinery, Bundaberg, Queensland
1901			Eastick, Samuel Philip, 25, Woodville-road, Ealing, W.
1903			Eastwood, Arthur William, B.A. (Cantab.), Newton College, Newton Abbot, S. Devon
1878	Trans.		‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1881			Edgell, R. Arnold, Rev., M.A., Sywell House, Llandudno, Wales
1903			Edgerton, John Percy, The Laboratory, 61, Cornhill, E.C.

Date of Election.		
1903		Edlin, Edgar Leeder, B.A. (Oxon.), 31, All Saints-road, Leicester
1903		Edminson, Sidney Robert, Maritzburg College, Natal, South Africa
1876		Edmunds, James, M.D., 4, Chichester-terr., Kemp Town, Brighton
1893		Edwards, Thomas, Brewery House, Rhymney, viâ Cardiff
1884		Edwards, Vincent, Lawes' Chemical Manure Co., Barking Creek, Essex
1902		Edwards, Walter Henry, The Grammar School, Wellingborough, Northants.
1892		Edwards, Walter N., 4, Herne Hill-road, Camberwell, S.E.
1898		‖Edwards, W. T. A., Experiment Station, Réduit, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc., Ph.D., Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany
1899		Eichenauer, W. F., 18, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, 143, New Bond-street, W.
1883		‖Ekins, Arthur E., Rushden, Lattimore-road, St. Albans
1887		Elborne, William, M.A. (Cantab.), Chemical Laboratory, Minster Precincts, Peterborough
1903		Elford, Archibald Sefton, B.A., 9, Keble-road, Oxford
1891		Elford, Percy, M.A., St. John's College, Oxford
1901		Eling, T. H. J., Nelson Endowed School, Wigton, Cumberland
1878		‖Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, W. J., M.A., The Grammar School, Leeds
1893		Ellis, C. Sordes, F.I.C., Meadowlead, Station-road, Harrow
1900		Ellis, F. R., 15, Shadwell-road, Bishopston, Bristol
1904		Ellis, Henry Russel, 177, Warwick-road, Kensington, W.
1901		Ellis, Hugh Edward, Preswylfa, Llanfair, near Welshpool
1878		Ellis, William Hodgson, M.A., M.B., School of Practical Science, Toronto, Ontario, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton
1888		Ellwood, Thomas A., M.R.C.S., L.R.C.P., 99, Tollington Park, N.
1893		Elmore, Alexander Stanley, 4, Broad-street-place, E.C.
1902		Elsden, Alfred Vincent, B.Sc. (Lond.), A.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E.
1886	Trans.	Elworthy, Herbert Samuel, Hamara Ghar, Battlefield-road, St. Albans, Herts.
1885		Embrey, George, County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton.
1901		English, R., Engineer and Manager, Christchurch Gas Co., Christchurch, New Zealand
1892		Entwistle, Herbert, 13, Curzon-avenue, Victoria Park, Manchester
1885		Epps, James, Norfolk House, Beulah Hill, Upper Norwood, S.E.

Date of Election.		
1899		Epps, James Washington, 95, Upper Tulse Hill, S.W.
1889		Erskine, J. Kerr, New Kleinfontein Co., Ltd., Post Office, Benoni, Transvaal, South Africa
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862		‖ Esson, William, Prof., F.R.S., Merton College, Oxford
1865		‖ Estcourt, Charles, Seymour House, Seymour-grove, Old Trafford, Manchester
1899		Estcourt, H. E., 467, West-street, Durban, Natal, South Africa
1888		‖ Estcourt, Philip Anderson, Seymour House, Seymour-grove, Old Trafford, Manchester
1894		Eumorfopoulos, Nicholas, B.Sc., 33, Gloucester-square, Hyde Park, W.
1895		Eutroppe, A. T., c/o Chief Surgeon, Division of the Philippines, Manila, Philippine Islands
1891		Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope
1876		Evans, Sir John, K.C.B., D.C.L., LL.D., F.R.S., Nash Mills, Hemel Hempstead
1892	Trans.	‖ Evans, Robert Cecil Turle, 9, Heathcote-street, Grays Inn-road, W.C.
1904		Evans, Nevil Norton, McGill University, Montreal, Canada
1888		‖ Everard, Arthur George, Normanhurst, 115, Broomwood-road, Wandsworth Common, S.W.
1902		Everitt, Walter, 83, The Grove, Ealing, W.
1894		Evershed, Frank, Kenley, Surrey
1896	Trans.	Ewan, Thomas, M.Sc., Ph.D., c/o Cassel Gold Extracting Co., Ruchill-road, Maryhill, Glasgow
1902	Trans.	Eynon, L., 57, Darenth-road, Stamford Hill, N.
1901	Trans.	Eyre, J. V., Chemisches Laboratorium, Liebig-strasse, Leipzig, Germany
1888		Faber, Harald N., 7 and 8, Idol-lane, E.C.
1903		Fairhall, Edwin Jesse, A.C.G.I., A.I.C., 29, Winsham-grove, Clapham Common, S.W.
1865	Trans.	‖ Fairley, Thomas, F.R.S.E., 17, East-parade, Leeds
1895		Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899		Fairweather, E. B., King's College Hospital, Lincoln's Inn Fields, W.C.
1888		Farlie, John B., 54, Wellington-road, Old Charlton, Kent
1903	Trans.	Farmer, Robert Crosbie, M.Sc. (Vict.), Ph.D. (Würzburg), Holmesdale, Pickford-road, Bexley Heath, Kent
1895		Farr, E. H., Uckfield, Sussex
1870		‖ Farries, Thomas, 16, Coleman-street, E.C.
1880		‖ Farrington, T., M.A., 5, Summerhill-terrace, Wellington-road, Cork

Date of Election.			
1902			Fasnacht, E. A., Clayton Mount, Newton Heath, Manchester
1894			Fawcett, Joseph Addey, 54, Broxholme-lane, Doncaster
1887			Fawsitt, Charles A., 9, Foremount-terrace, Dowanhill, Glasgow
1903	Proc.		Fawsitt, Charles Edward, Ph.D., D.Sc., Chemical Department, The University, Glasgow
1900			Fechtner, A. L. W., 33, Salon New-road, Clapham, S.W.
1888			Fell, John Campbell, 55, Rutland-park-mansions, Willesden Green, N.W.
1897			Fenby, A. V. C., B.Sc., Market Bosworth, Nuneaton
1878	Trans.	C. 1898-1902	‖Fenton, H. J. H., M.A., F.R.S., Christ's College, and 19, Brookside, Cambridge
1872		C. 1889-93	‖Ferguson, John, Prof., M.A., LL.D., The University, Glasgow
1898			Ferguson, J. E., Laboratory and Assay Office, 2, Union-court, Old Broad-street, E.C.
1901			Ferguson, R. W., Municipal Technical School, The Gamble Institute, St. Helens
1899			Fermor, H. F. F. B., 15, Ansdell-road, Peckham, S.E.
1901			Ferrand, F., 13, Torrington-street, Hopwood, Heywood
1864			‖Ferreira, A. A.
1882			Ferrier, James, Columbus, Georgia, U.S.A.
1902			Ferrier, John Oliver, Ackland House, Slave Island, Colombo, Ceylon
1902			Ferris, Percy J., Heathfield, Cherry Lane, Lymm, Cheshire
1904			Field, W. Eddington, 65, Sutherland-road, Armadale, Melbourne, Australia
1895			Fielding, P. J. D., 2, Holmwood-terrace, Southern-road, Cork
1900	Trans.		Findlay, Alexander, M.A., Ph.D., D.Sc., The University, Birmingham
1904			Finlow, Robert Steel, B.Sc. (Wales), c/o Messrs. Grindlay and Co., Calcutta, India
1896			Fisher, E. H., The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Frederick William, M.A., 64, Pont-street, S.W.
1900			FitzGibbon, Thomas, 14a, Kenyon-street, Fulham, S.W.
1896			Fleet, J. T., 24, Sheep-street, Rugby
1899			‖Fleischmann, F. N. A., 6, Collingham-gardens, South Kensington, S.W.
1898			‖Fleming, J. A., Britannia Pottery, 136, Glebe-street, Glasgow
1903			Fletcher, Alan, 52, Queen's-road, Twickenham, Middlesex
1874			Fletcher, Frederick W., North London Chemical Works, Holloway, N., and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A., F.R.S., Natural History Department, British Museum, Cromwell-road, S.W., and 35, Woodville-gardens, Ealing, W.

Date of Election.			
1894			‖Flintoff, Robert J., Daisy Villa, Todmorden-road, Littleborough, Lancs.
1892			Floris, Robert Brooke, Church House, West Hanningfield, near Chelmsford
1894			Fogg, C. A., "Graythorne," Albert-road, Bolton
1859			Fogg, Thomas, 93, Portsdown-road, Maida Vale, W.
1889			Foggie, John, University College, Dundee
1902			Foll, Edgar, The Cottage, The Lion Brewery, Belvedere-road, Lambeth, S.E.
1885			Follows, Harold, 11, Park-avenue, Longsight, Manchester
1894			‖Forbes, D. G., Shillingstone, Blandford
1874			Forbes, James, jun., 70, Gracechurch-street, E.C.
1889	Trans.		Ford, John Simpson, c/o Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton
1904			Forrest, James Rocheid, Major, D.P.H. (Cantab.), Kirkee, Poona, India
1893			Forrester, Alexander M., c/o Messrs. Laidlaw, MacKill and Co., Ltd., 3400, Williamsburg-avenue, Richmond, Virginia, U.S.A.
1892	Trans.	C. 1901-04. S. 1904-	‖Forster, Martin Onslow, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Royal College of Science, South Kensington, S.W.
1903			Forster, William, 30, Church-street, Seaham Harbour
1856	Trans.	C. 1865-8, 72-5, 85-6 V.P. 88-92	‖Foster, G. Carey, Prof., F.R.S., Ladywalk, Rickmansworth, Herts.
1872			Foster, Reginald Le Neve, Harrytown Hall, Bredbury, near Stockport
1900			Foulds, James, Alva, 8, Dorking-road, Tunbridge Wells
1898			Foulerton, A. G. R., F.R.C.S., L.R.C.P., Haywards Heath, Sussex
1891	Trans.		‖Fowler, Gilbert J., D.Sc., Broad Oak, Urmston, Manchester
1900			Fowler, M. B., 19, Westbury-road, Westbury-on-Trym, near Bristol
1882			‖Fowler, William, M.Sc., 1, Grace-terrace, Sunderland
1895			Fox, A. Stanley, 23, South-road, Faversham
1884			‖Foye, Martin Hugh, M.B., C.M.
1879			Francis, Edward, Ivy Bank, Park Ravine, Nottingham
1902	Trans.		Francis, Francis Ernest, Ph.D. (Erlangen), B.Sc. (Vict.), A.I.C., University College, Bristol
1873			‖Francis, G. Bult, 38, Southwark-street, S.E.
1881			Frankland, Henry, Streonshalh, The Crescent, Linthorpe, Middlesbro'.
1880	Trans.	C 1887-9 V.P. 1902-	‖Frankland, Percy Faraday, Prof., LL.D., Ph.D., M.Sc., B.Sc., A.R.S.M., F.R.S., F.I.C., The University, Birmingham
1867			‖Fraser, Angus, M.D., 232, Union-street, Aberdeen

Date of Election.			
1892			‖Fraser, James C., Mercantile-chambers, Victoria-square Adelaide, South Australia
1885			Freear, Harry M., Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick W., "Heatherdale," Spenser-road, Harpenden, Herts.
1900			Freeman, W. L., M.A., 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph T., Fenestella, Egerton Park, Rock Ferry, Cheshire
1892	Proc.		French, William, M.A. (Cantab.), F.I.C., Storey Institute, Lancaster
1889	Trans.		Frew, William, Ph.D. (Munich), King James'-places, Perth, N.B.
1903	Trans.		Friend, John Albert Newton, M.Sc. (Birm.), 2, Francis-road, Watford, Herts.
1871	Trans.	{C. 1884-9, 92-6}	‖Friswell, Richard John, F.I.C., Fairfield, Bexley, Kent
1890			‖Frost, Robert, B.Sc., 53, Victoria-road, Kensington, W.
1904			‖Fry, George, Carlin Brae, Berwick-on-Tweed
1899			Fry, G. C., M.Sc., 71, George-street, Saltaire, Shipley, Yorks.
1899	Trans.		Frye, Colin C., 48, Woodville-gardens, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A., Ph.D., F.I.C., 13, Eaton-crescent, Clifton, Bristol
1895			Fuerst, A. F., Ph.D., 30, Wood-street, E.C.
1891			Fulcher, Lionel William, B.Sc., Victoria and Albert Museum, S.W., and 56, Buckleigh-road, Streatham Common, S.W.
1896			Fuller, C. J. P., 79, Brownlow-road, Horwich, Lancs.
1886			Fuller, John, Rookwood, Montpelier-road, Ealing, W.
1894			‖Gabb, George Hugh, 43, Charlotte-street, Fitzroy-square, W.
1899			Gabriel, E. V., Ajmere, Rajputana, India
1901			Gadd, H. W., 42, Union-road, Exeter
1901			Gajjar, T. K., Prof., Gingaum, Bombay, India
1866			Gale, James, M.A., Ph.D., F.G.S., 124, Adelaide-road, South Hampstead, N.W.
1851			‖Gamble, Sir David, Bart., C.B., Windlehurst, St. Helens, Lancs.
1876			Gamble, J. C., Haresfinch, St. Helens, Lancs.
1903			Gandy, William Hunter, Bradley Court, Mitcheldean, Gloucester
1883	Proc.		‖Garbutt, Llewellyn, M.A., 10, College-street, Winchester
1903			Gardiner, Ernest Alexander, B.A. (Oxon.), The College, Plymouth
1888			Gardiner, James H., 59, Wroughton-road, Balham, S.W.
1901			Gardner, H. C. T., Miller Hospital and Royal Kent Dispensary, Greenwich-road, S.E.
1898			Gardner, James E., 413, Park-road, Oldham
1893	Trans.		Gardner, John Addyman, M.A., Chemical Department, St. George's Hospital, S.W.

Date of Election.		
1888		Gardner, Walter M., Prof., Technical College, Bradford, and 3, Fairmount, Manningham, Bradford
1902		Garle, John Longsdon, A.I.C., 136, Holland-road, Kensington, W.
1893	Trans.	Garnett, Henry, 49, Market-square, Witney, Oxon.
1889	Trans.	Garrett, Frederic Charles, M.Sc., Armstrong College of Science, Newcastle-on-Tyne
1898		Garside, A. L. H., B.Sc., c/o Dr. Miller, Kilvert's-buildings, Withy-grove, Manchester
1884		Gaskell, Joseph, 71, Haworth's-buildings, Cross-street, Manchester
1900		Gasson, W., Dutoitspan-road, Kimberley, South Africa
1904		Gatehouse, Frank Brooks, "Hillside," London-road, Greenhithe, Kent
1847		Gatty, F. A., Bannister Hall Works, near Preston, Lancs.
1904	Trans.	Gawler, Robert, M.Sc. (Vict.), 3, South View-terrace, Bennett-road, Headingley, Leeds
1887		Geisler, Joseph F., Mercantile Exchange Buildings, Hudson and Harrison-streets, New York, U.S.A.
1885		Gemmell, George Harrison, 4, Lindsay-place, Edinburgh
1904		Gent, Percy William, 792½, Ridge-street, Forest Hill, Newark, New Jersey, U.S.A.
1879		Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Director of Technical Instruction, Auckland, New Zealand
1904		Gerard, Thomas Alfred, 122, Foxhall-road, Nottingham
1889		‖Gerland, Conrad, M.Sc., Ph.D., Meadow Bank, Accrington
1891		German, George, jun., Mansion House, Ashby-de-la-Zouch
1895		‖Gerrans, H. Tresawna, M.A., 20, St. John-street, Oxford
1875		Gerrard, A. W., 35, Queen's-road, Wimbledon, S.W.
1899		Getman, F. H., 811, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Lieut.-Col. I.M.S., Chemical Examiner, Medical College, Madras, India
1904		Ghose, Anu, 42, Shambazar-street, Calcutta, India
1890		‖Gibbes, Cuthbert C., M.D., M.C., L.R.C.P., D.P.H., 89 Harley-street, W.
1900		Gibbings, G. W., Standard Bank of South Africa, Salisbury, Rhodesia, South Africa
1897		Gibbons, J. L., The Higher Grade School, Blyth, Northumberland
1885		Gibson, Adam, c/o Messrs. Pinkerton, Gibson & Co., Thistle-street-lane East, Edinburgh
1900		Gibson, John, Roseneath Cottage, Hexham
1892	Trans.	Gibson, John, Ph.D., F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1888		Gibson, W. Humphrey, 122, King's-road, Brighton

Date of Election.		
1898		Gidden, W. T., The Hawthorns, Moat-road, Langley, near Birmingham
1895		Gilbard, John Francis Hutchins, 245, Dalston-road, Hackney, N.E.
1904		Gilchrist, James Gray, M.A. (Aberdeen), 48, Ovington-street, Chelsea, S.W.
1898		Gilderdale, Frederick, 3, Havelock-street, Newcastle-on-Tyne
1883		‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants.
1888		Gill, John, Gwealhellis, Helston, Cornwall
1902		Gill, J. Arthur, 10, Manor-road, Rusthall, Tunbridge Wells
1898	Proc.	Gilles, W. S., Bradford-street, Bocking, Braintree, Essex
1865		‖Gillman, A. W.
1901		Gillman, E., Government Laboratory, Barbados, West Indies
1885		Girdwood, Gilbert P., M.D., C.M., 111, University-street, Montreal
1897		Girtin, Thomas, M.A., 125A, Highbury New Park, N.
1898		Glaister, John, Prof., M.D., 18, Woodside-place, Glasgow
1872		‖Glover, George Thomas, 24, Craven Hill-gardens, Lancaster Gate, W.
1904		Glover, Harry James, 33, Albert-road, Stroud Green, N.
1895		Goldfinch, George, 7, Church-walk, Hendon, N.W.
1899		Golding, John, Midland Agric. and Dairy Inst., Kingston, Derby
1878		‖Goldschmidt, S. A., Ph.D., c/o Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, New York, U.S.A.
1889		Goldsmith, Byron B., 19, East 74th-street, New York City U.S.A.
1898		Goldsmith, John Naish, B.Sc., Ph.D., British Xylonite Co. Manningtree, Essex
1896		Goldstanda, Leóna Felixa, Nowo-Zielna 48, Warsaw, Russian Poland
1899		Goltz, H. F. C., 155, Brixton Hill, S.W.
1897		Gomess, A. F. Bilderbeck, M.R.C.S., L.R.C.P., 33, Drayton-gardens, South Kensington, S.W.
1904		‖Goodson, John Augustus, 19, Darnley-road, Hackney, N.E.
1890		Goodwin, Thomas Small, Prof., M.B., C.M., F.R.S.E., 54, South-street, Isleworth, Middlesex
1896	Trans.	Goodwin, William Lawton, Thorncliffe, Macclesfield
1890		Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1887	‖Proc.	Gordon, Hugh, M.A. (Oxon.), Ryton-grove, Ryton-on-Tyne, Co. Durham
1875		Gordon, J. G., Queen Anne's Mansions, Westminster, S.W.
1890		Gossling, Frank, B.Sc., H.M. Patent Office, Staple Inn, W.C.
1889	Trans.	‖Gott, B. S., M.A., The Guildhall, Westminster, S.W.
1903		Gough, Henry, Greenwich Brewery, Greenwich, S.E.
1900		Gough, J. H., 65, Grange-avenue, Chapeltown-road, Leeds

Date of Election.			
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, D.Sc. (Lond.), 98, Stroud Green-road, N.
1887			Gover, Herbert J., 29, Piccadilly, Hanley, Staffs.
1902			Gow, Alexander, Hill Crest, Grappenhall, Cheshire
1889			Gow, Robert J., Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, "Ashleigh," Furness Park-road, Barrow
1871	Trans.	C. 1898-1901.	‖Gowland, William, Prof., A.R.S.M., 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George A., Hawkins-road, Medindie, Adelaide, South Australia
1884			Grace, William Frank, 30, Hartington-villas, Hove, Sussex
1880	Trans.		‖Graham, C. Colborne, Highmoor, Ben Rhydding-road, Ilkley, Yorks.
1862		C. 1880-1	‖Graham, Charles, D.Sc., The Reculvers, Hastings
1895	Trans.		Graham, Edward, B.Sc., Highcroft, Tilehurst, Berks.
1890	Trans.		Grant, James, F.I.C., 9, Arthur-street, Prestwich, near Manchester
1887			Gravill, Edward D., F.R.M.S., 42, Walmsley-street, Hull
1882			Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900	Proc.		Gray, R. W., 7, Ormo-court, Bayswater, W.
1892	Trans.		Gray, Thomas, B.Sc., Ph.D., 204, George-street, Glasgow
1895			Greaves, W. A., 20, Beacon Hill-road, Newark
1890			Green, Alfred H., Oaklands, Lowton, Newton-le-Willows, Lancs.
1885	Trans.	C. 1894-5	‖Green, Arthur George, Prof., The University, Leeds, and 2, Dartmouth-road, Brondesbury, N.W.
1893			Green, Arthur Henry, Heathfield, St. Anne's-road East, St. Anne's-on-the-Sea, Lancs.
1902	Trans.		Green, C. J., B.Sc., c/o Messrs. Nicholson and Co., Beaumont Works, St. Albans
1903			Green, George Felix Dudbridge, c/o Messrs. Davey and Co., Gainsboro'-road, Hackney Wick, N.E.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, A.R.S.M., Broadlea, Urmston, near Manchester
1878			Green, Lawrence, Lower Tovil, Maidstone
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey
1885			Greenway, Thomas J., 2nd Avenue, St. Peter's, South Australia
1873			Greenwood, William Henry, Birmingham Metal and Munitions Co., Ltd., Adderley Park Works, Birmingham
1894	Proc.		Greeves, A., 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D., B.Sc., Colonial Secretary's Office, Cape Town, South Africa
1885			Gregory, G. M., 36, Gunterstone-road, West Kensington, W.

Date of Election.			
1883			‖Grenfell, Claud, M.A., c/o Miss Boole, 16 Ladbroke-road, W.
1874			Greville, Henry Leicester, Peniston, 51, Hafton-road, Catford, S.E.
1896			Grice, W. T., 9, Dalhousie-square, Calcutta, India
1888			‖Griffith, D. Agnew, The Houghlands, Kelsall, Chester
1902			Griffiths, John T., The County School, Tenby, S. Wales
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 10, Brookfield-villas, Aldcliffe-road, Lancaster
1903			Grimwade, Wilfrid Russell, B.Sc. (Melbourne), 342–346, Little Flinders-street, Melbourne, Australia
1880			Grimwood, Robert, London County Council, Chemical and Gas Department, 40, Craven-street, W.C.
1893			Grimwood, Robert George, 17, Dagmar-road, Stroud Green, N.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire
1900			Gritton, H. B., The Cottage, Balmain, Sydney, N.S.W.
1895			Grossman, E. H., 12, Alfred-place West, South Kensington, S.W
1871	Trans.	C. 1877-8 V.P. 1899-1902.	‖Groves, Charles Edward, F.R.S., Kennington-green, S.E.
1901			Groves, W. Peer, Green Bank, Plumbley, Cheshire
1897			Grundey, F. R., B.Sc., 33, Woodburn-square, Douglas, Isle of Man
1904			Grundy, Frank Barnes, Victoria Mills, Bredbury, near Stockport
1897			Guest, E. Graham, M.A., B.Sc., 5, Churchill, Edinburgh
1903			Gumersall, Edward, 21, New-road, Rochester, Kent
1895			Gunn, Alexander, Duns, Berwickshire
1902			Gunn, Gilbert, 181, Bury New-road, Summit, Heywood, Lancs.
1899			Gurney, E. H., Agricultural College, Gatton, Queensland
1898			Guthrie, Alexander, B.Sc., The Cottage, Bocking, Braintree, Essex
1888	Trans.		Guthrie, Frederick Bickell, Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1904			Guthrie, John Monteath, 199, Ferry-road, Leith, N.B.
1904			Guttmann, Leo Frank, Ph.D. (Heidelberg), A.C.G.I., A.I.C., 18, Aberdare-gardens, N.W.
1897			Guttmann, Oscar, F.I.C., 12, Mark-lane, E.C.
1902	Trans.		Haas, P., B.Sc., Ph.D., 11, Westbourne-park-road, W.
1874			Habirshaw, W. M., Glenwood Works, Yonkers, New York, U.S.A.
1901			Haddon, H. E., Pamplemousses, Mauritius
1878			‖Hadkinson, John.
1894			Hadley, Arthur, c/o Messrs. Crowley & Co., Ltd., The Brewery, Alton, Hants.

Date of Election.			
1898			Hadley, E. B., "Dalham Villa," Granville-road, Southfields, S.W
1893			‖Hadley, Henry Edwin, School of Science, Kidderminster
1886	Trans		Haga, Tamemasa, D.Sc., College of Science, University of Tokio, Japa
1899			Haigh, Percy, c/o Messrs. Bird Bros., Duxford, Cambridge
1881			Hailes, Alfred James de, 15, Red Lion-square, W.C.
1892			Haines, Walter S., Prof., c/o Rush Medical College, Chicag U.S.A.
1876	Trans.		Hake, H. Wilson, Ph.D., Westminster Hospital Medical Schoo Caxton-street, S.W.
1893			Hale, Henry Ormsby, Oundle School, Northants.
1891	Trans.	C. 1904-	Hall, Alfred Daniel, M.A., Lawes Agricultural Trust, Rothamste Experimental Station, Harpenden, Herts.
1891			Hall, Allan T., The Cottage, Kirk Ella, near Hull
1889			Hall, Archibald, 34, Bishopsgate-street, E.C.
1889	Trans.		Hall, John A., Victoria Chemical Works, Victoria, B.C.
1903			Hall, John T., West View, Stanwell, Staines
1876			Hall, Samuel, East London Soap Works, Bow, E.
1899			‖Hall, S. G., 19, Aberdeen-park, Highbury, N.
1893			Haller, Albin, Prof., 1, Rue de Goff, Paris
1886			Halliburton, William Dobinson, Prof., M.D. (Lond.), B.Sc. F.R.C.P., F.R.S., Church Cottage, 17, Marylebone-road, W.
1897			Halliwell, Edward, c/o Ribble Joint Committee, 2, Stanley-place Preston
1902			Hallowell, Thomas Butterworth, Ladyshawe House, New Mills West Stockport
1900			Halstead, R. G., 12 and 16, Coleman-street, E.C.
1859			‖Hambly, C. H. Burbridge, "Fairley," Weston, Bath
1890	Trans.		Hambly, Frederick J., c/o The Electric Reduction Co., Buckingham, Que., Canada
1888	Trans.		Hamilton, James C., Arncliffe, Arnside, viâ Carnforth
1898			Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks.
1897			Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans.		Hamlet, William Mogford, F.I.C., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1901			Hammond, H. B., 41, St James'-street, Dover
1901			Hammond, Harold Sankey, Government Laboratory, Kingston, Jamaica
1877			Hampton, William, 38, Lichfield-street, Hanley
1857			Hanbury, Cornelius, Plough-court, Lombard-street, E.C., and Dynevor House, Richmond, Surrey
1900			Handcock, W. A., 40, Avenue-road, Highgate, N.
1895	Trans		Hanes, Edgar Septimus, 34, Keyes-road, Cricklewood, N.W.
1896			Hanger, R. H., Hawthorn-villa, Newland, Hull
1900			Hanley, John, 32, Wentworth-avenue, New Brighton, Cheshire

Date of Election.			
1902	Trans.		Hann, Archie Cecil Osborn, 54, Wood-vale, Forest Hill, S.E.
1872	Trans.		‖Hannay, James Ballantyne, Cove Castle, Loch Long, N.B., and Whitehall Club, S.W.
1889			‖Hanson, Alfred Miall, The Whalley Abbey Printing Co., Ltd., Whalley, near Blackburn
1901	Trans.		Hanson, Edward Kenneth, B.A., Mapledene, Hadley Wood, N.
1895			Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton-on-Tees
1897			Harbord, F. W., Surbiton House, Englefield Green, Surrey
1859	Trans.	S. 1865-73 V.P. 73-6 80-3, 92-5 P. 1895-7	‖Harcourt, A. G. Vernon, M.A., D.C.L., LL.D., F.R.S., St. Clare, Ryde, Isle of Wight
1863			‖Harcourt, L. F. Vernon, M.A., Haddon House, Weybridge
1887	Trans.	C. 1902-	‖Harden, Arthur, M.Sc., Ph.D., 2, Marlborough-road, Richmond Surrey
1902			Harding, H., 47, Streathbourne-road, Upper Tooting, S.W.
1885			Hards, W. B., B.A., Board of Education, South Kensington, S.W
1892			Hardy, J. Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1898			Hargreaves, A. F., Esk Hill, Rosslyn, Midlothian
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes
1884			Hargreaves, John, Widnes, Lancs.
1901			Hargreaves, William Arthur, M.A., F.I.C., Government Analyst, Adelaide, S. Australia
1901			Harker, George, D.Sc., 35, Boulevarde, Petersham, Sydney, N.S.W.
1876			‖Harland, Robert Henry, 37, Lombard-street, E.C.
1878			‖Harland, William Dugdale, 48, King-street, Manchester
1897			Harley, Vaughan Berkeley, Prof., M.D., 25, Harley-street, W.
1874			‖Harman, F. E., c/o Dr. Piggott, 13, Orchard-gardens, Teignmouth, Devon
1897			Harman, Harold W., Shalmsford, Brixton Hill, S.W.
1903			Harmer, Francis Gerald, Middle Class School, Vernon-road, Leeds
1899			Harper, H. W., M.D., The University of Texas, Austin, Texas, U.S.A.
1897			Harrie, H. W., c/o Messrs. Harker, Stagg and Morgan, 15, Lawrence Pountney-lane, E.C.
1897			Harrington, B. J., Prof., M.A., Ph.D., McGill University, Montreal, Canada
1896			Harrington, William, 9, Edgehill-terrace, Bransby, Whitehaven
1881			Harrington, William Bury, Leeview, Montenotte, Cork
1896			Harris, F. W., Sanitary Chambers, Glasgow
1893			Harris, Harold, c/o Messrs. Dalgety and Co., Ltd., Sydney, N.S.W.
1895			Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia

Date of Election.			
1874			Harris, Henry Penley, 8, Howard-road, Cricklewood, N.W.
1894			Harris, Sydney Walters, Devon House, Walter-road, Swansea
1878			‖Harris, Thomas Frederick, B.Sc., The Firs, Kennardington, Ashfor
1895			Harris, Walter, M.A., Ph.D., Sutherland Institute Technica School, Longton, Staffs.
1888			‖Harrison, Albert, Delamere, Grove-road, South Woodford, Esse
1894	Trans.		Harrison, Edward Frank, B.Sc. (Lond.), Mayfield, Selborn road, Sidcup, Kent
1883			‖Harrison, Hugh Erat, B.Sc., 28, Sussex-place, Regent's Park, N.W. and Faraday House, Charing Cross-road, W.C.
1901			Harrison, John Ansted, B.Sc., Brayton House, Wellington-row Whitehaven
1888			Harrison, John Burchmore, C.M.G., M.A., F.I.C., Governmen Laboratory, George Town, Demerara, British Guiana
1902			Harrison, Walter Ernest, 15, Lansdowne-road, Handsworth Birmingham
1891			Harrold, Frederick W., 18, Maddox-street, W.
1876	Trans.		Harrow, George Harrow Unwin, Ph.D., F.I.C., Messrs. Allsop and Sons' Brewery, Burton-on-Trent
1901			Harry, F. T., 106, Sandmere-road, Clapham Common, S.W.
1886			Hart, Bertram Harvey, The Elms, Old Charlton, Kent, S.E.
1869			‖Hart, F. W., Holly House, 96, Stoke Newington-road, N.
1900			Hart, H. W., 13, Lynwood-villas, Darwen, Lancs.
1891			Hart, William Beaumont, Laboratory, 8, Exchange-street, Man chester
1882			Hartley, Arthur, The Brewery, Emsworth, Hants.
1897			Hartley, E. G. J., B.A., The Bungalow, Foxcombe Hill, nea Oxford
1899			Hartley, Harold Brewer, B.A., Balliol College, Oxford
1897			Hartley, Thomas, Swindon and North Wilts. Technical School Swindon
1866	Trans.	C. 77-80 V.P. 90-3	Hartley, Walter Noel, D.Sc. (R.U.I.), F.R.S., F.R.S.E. F.I.C., Hon. Fellow King's Coll., Lond., Royal College Science, Stephen's-green, Dublin; and 36, Waterloo-road Dublin
1890	Trans.		Hartog, Philip Joseph, B.Sc., 22, Brondesbury-villas, N.W.
1900	Trans.		Hart-Smith, James, F.I.C., A.R.C.S., 4, Grafton-mansions Venn-street, Clapham, S.W.
1900	Trans.		Harvey, A. W., 13, Pendrell-road, St. Catherine's Park, Hatcham S.E.
1885			Harvey, Ernest William, A.R.S.M., Stoneleigh, 23, Grove road, Clapham Park, S.W.
1881			Harvey, Sidney, Canterbury
1894			Harvey, W. Pellew, 31, Walbrook, E.C.

Date of Election.			
1894			Hatfield, J. Adams, c/o Messrs. J. Lysaght, Ltd., Orb Iron Works, Newport, Mon.
1892			Hatton, William Percy, c/o Messrs. W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred E., M.D. (Brussels), L.R.C.P. (Edin.), 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, Edward, D.Sc., Sunnyside, Norman-road, Runcorn, Cheshire
1898			Haworth, John, 32, Marriott-road, Millhouses, near Sheffield
1900			Haynes, J. H., B.Sc., Essendene, Seymour-road, Ashley Down, Bristol
1887			Head, C. James, F.I.C., 16A, Wirtemberg-street, Clapham, S.W.
1903			Heasman, Harold Montague, 2, Broadway, Westminster, S.W.
1891			Heath, John William, 33, Upper Gloucester-place, W.
1898			Heaton, John, 1, Belle Vue-park, Sunderland
1902			Heaton, Noël, B.Sc., c/o Messrs. J. Barnard and Son, 19, Berners-street, W.
1899			Hedley, G. W., M.A., 2, St. Luke's-terrace, Cheltenham
1876		C. 1895-9	Hehner, Otto, 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, Simonstone, 27, Hammelton-road, Bromley, Kent
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, J. W., 3, Tavistock-road, Croydon
1899			Hembrough, James, A.R.C.S., 7, Park-view, Beeston Hill, Leeds
1900			Hemingway, Frank Christian Richard, 133, Front-street, New York City, U.S.A.
1898	Trans.		Hemmy, A. S., Prof., B.A., M.Sc., Government College, Lahore, India
1885	Trans.		‖Henderson, George G., Prof., M.A., D.Sc., F.I.C , The Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, B.Sc., Ph.D., c/o Messrs. Horlick and Co., Racine, Wisconsin, U.S.A.
1900	Trans.		Henderson, J. B., Government Analyst, Brisbane, Queensland
1892			Hendrick, James, B.Sc., F.I.C., Marischal College, Aberdeen
1904			Hendrickson, Arthur V., The Gas Works, Lower Sydenham, S.E.
1901			‖Henley, The Hon. F. R., B.A., 9, Beaufort-gardens, S.W.
1902			Hennesey, Eugene Edwin, B.A., B.Sc., 57, Allison-road, Harringay, N.
1899	Trans.		Henry, T. A., D.Sc. (Lond.), 70, Doneraile-street, Fulham, S.W.
1853			Hepburn, J. G., LL.B., Dartford, Kent
1895			Heriot, T. H. P., 23, Wolseley-road, Crouch End, N.

Date of Election.			
1871			Herman, Douglas, Rainhill, Lancs.
1876	Trans.	C. 1892-3	Heron, John, B.E. (R.U.I.), F.I.C., 110, Fenchurch-street, E.C.
1892	Trans.	C. 1903-	Hewitt, John Theodore, M.A., D.Sc., Ph.D., 8, Montpelier-road, East Twickenham
1900			Hewitt, Samuel, 3, Chester-street, Norwich
1900			Hewitt, W. H., B.A., King's College, Strand, W.C.
1892			Hewlett, John C., 40, Charlotte-street, Great Eastern-street, E.C.
1883	Trans.	C. 1897-1901.	‖Heycock, Charles T., M.A., F.R.S., 24, Fitzwilliam-street, Cambridge
1890			Heywood, Joseph H., 231, Drake-street, Rochdale
1848			Heywood, J. S. C., Export Department, Storer's Wharf, Poplar, E.
1876	Trans.		Hibbert, Walter, 101, Goldhurst-terrace East, South Hampstead, N.W.
1894			Hichens, J. H., M.A., F.G.S., The School House, Wolverhampton
1881			‖Hiddingh, Michael, Newlands, near Capetown, South Africa
1901			Higgs, H. H., B.Sc., "Ivanhoe," Highbridge-road, Wylde Green, Birmingham
1894			Higgs, M. Stanger, Southern Main Reef Estates, Ltd., Mine Office, Venterskroon, Transvaal, South Africa
1882			‖Hill, Alexander.
1896	Trans.		Hill, Arthur Croft, M.A., M.D., B.S., (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 169, Cromwell-road, S.W.
1896			‖Hill, Charles Alexander, 15, Brunswick-gardens, Kensington, W.
1896	Proc.		Hill, E. G., Prof., B.A., Muir College, Allahabad, India
1897			Hill, Sydney, 86, Park-avenue, Hull
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, London, S.W.
1892			‖Hills, Harold F., Commercial Gas Works, Stepney, E.
1898			Hills, T. H., 6, Eliot Park, Blackheath, S.E.
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, J. W., A.R.S.M., Royal Mint, Bangkok, Siam
1903			Hindmarsh, Leonard King, B.A. (Oxon.), The Grammar School, Sutton Coldfield, near Birmingham
1900			Hinks, Percy John, A.R.C.S., F.I.C., Tavern-street, Stowmarket
1894			Hirsch, C. T. W., M.D., Charlinch, Rectory-road, Woolwich S.E.
1870			Hislop, George R., Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, R. F., Craigielea, Paisley
1883			‖Hobbs, Bede, Lamb Brewery, Chiswick, W.
1901			Hobson, Edwin, Howdendyke, Howden, Yorks.

Date of Election.			
1884			Hodges, Herbert J., Dagmar, Napier-avenue, Fulham, S.W.
1882	Trans.		‖Hodgkin, John, F.L.S., F.I.C., 97, Hamlet-gardens-mansions, Ravenscourt Park, W.
1879	Trans.	C. 1883-5	Hodgkinson, W. R. Eaton, Prof., Ph.D., F.R.S.E., 18, Glenluce-road, Blackheath, S.E.
1886			Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, H. McAlpin, Foxhill Bank Print Works, Church, near Accrington
1873			‖Hodgson, H. Tylston, Harpenden, Herts.
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D., Laboratoire Municipal, Caserne de la Cité, Paris
1904			Hoit, Alfred Henry, 4, Montgomerie-road, Southsea
1876			Holcroft, Harold, M.A., Parkdale, Wolverhampton
1901			Holdcroft, George Frederick, 16, De Gray-street, Beverley-road, Hull
1885			Holgate, Thomas, 5, Victoria-street, Westminster, S.W.
1876			Holland, Philip, 22, Taviton-street, Gordon-square, W.
1903			Hollingworth, David Vincent, 3, Adelphi-terrace, Crescent, Salford
1891			Holloman, Frederick R., Southern-road, Plaistow, E.
1886			Holloway, George Thomas, 57 and 58, Chancery-lane, W.C.
1895			Holme, A. E., M.A., The Wheelwright Grammar School, Dewsbury
1897	Trans.		Holmes, John, Government Laboratory, Clement's Inn Passage, W.C.
1898	Trans.		Holroyd, George William Fraser, B.A., 1, Carlton-gardens, Ealing, W.
1902	Proc.		‖Holt, Alfred, jun., B.A., Crofton, Aigburth, Liverpool
1893			Holthouse, H. B., 12, Melton-grove, West Bridgford, Notts.
1898			Homfray, David, B.Sc., 6, Dartmouth-row, Greenwich, S.E.
1878			Hooker, A. H., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel C., 4422, Chestnut-street, Philadelphia, U.S.A.
1883			‖Hooper, David, Curator, Economic and Art Section, Indian Museum 1, Sudder-street, Calcutta, India
1888			‖Hooper, E. Grant, 16, Royal-avenue, Sloane-square, S.W.
1891			‖Hooper, Ernest F., Wear Fuel Works, South Dock, Sunderland
1902			Hopwood, Arthur, 49, Stanley-street, Tunstall, Stoke-on-Trent
1904			Horn, George Mathieson, Ivylands, Epping, Essex
1894			‖Hornby, R., M.A., Haileybury College, Hertford
1897			Horseman, J. W., County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901	Proc.		Horton, Edward, 8, Orford-street, Chelsea, S.W.

Date of Election.			
1892			Horwill, Edgar E. C., 6, Devereux-road, New Wandsworth, S.W.
1903			Hosking, Arthur Francis, c/o The Aruba Gold Concession, Ltd., Aruba Island, Dutch West Indies, viâ Curaçao
1886			‖Hoskins, Arthur Percy, Clonlee, Rosetta Park, Belfast
1871			Houlder, W. W., North Hyde House, Southall
1901			Houldershaw, Arthur, 4, Beacons-street, Low Fell, Gateshead-on-Tyne
1887	Proc.		Houlding, William, B.Sc., Arisaig, Aigburth Drive, Liverpool
1900			Houston, Adam, Brisbane House, Bellahouston, Glasgow
1896			Howard, Albert, South Eastern Agricultural College, Wye, Ken
1882			‖Howard, Alfred G., Burnt House, Chigwell, Essex
1901			Howard, B. F., Devon House, Buckhurst Hill, Essex
1870		C. 1875-9, 83-5, 98-1902. V.P. 1886-9, 1903-	‖Howard, David, Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, D. Lloyd, jun., Little Friday Hill, Chingford, Essex
1889			Howard, George William, Calverley, Tunbridge Wells
1875			Howard, Thomas, 50, Ellington-street, Liverpool-road, N.
1904			Howarth, John George, "Danes Dyke," Lowther-road, Bournemouth
1882			Howe, J. Lewis, M.D., Ph.D., Prof., Washington and Le University, Lexington, Va., U.S.A.
1898			Howe, Walter, 5, Blenheim-road, Bradford
1880			Howell, Reginald, 95A, Southwark-street, S.E.
1876			Howie, W. L., Hanover Lodge, West Hill, Harrow
1903			Howorth, Franklin Wise, 46, Lincoln's Inn Fields, W.C.
1889			‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham Lancs.
1889			Hoyles, Henry Richardson, 10, Fore-street, Wellington, Somerse
1871			‖Hudleston, W. H., M.A., F.R.S., 8, Stanhope gardens, S.W.
1900			Hudson, E. F., B.A., Churcher's College, Petersfield, Hants.
1878			Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899			Hübner, Julius, Ash-villa, Cheadle Hulme, Cheshire
1901			Hughes, Edward, Rev. Canon, The Rectory, Barmouth
1903			Hughes, Edwin Reginald, 106, Queen Victoria-street, E.C.
1894	Trans.		Hughes, Frank, c/o Khedivial Agricultural Society, P.O. Bo 63, Cairo, Egypt
1880	Trans.		Hughes, George Henry, 155, Fenchurch-street, E.C.
1868			Hughes, John, Analytical Laboratory, 79, Mark-lane, E.C.
1896			Hughes, J. A., 1, Bridewell-street, Bristol
1885			Hughes, T. Vaughan, 26, Barnsley-road, Edgbaston, Birmingha
1882			Hughes, Thomas, Borough Analyst's Office, 31, Loudoun-square Cardiff
1904			Hulme, John, 5, Duke-street, Macclesfield

Date of Election.		
1883		Humphrys, Norton H., 4, The Paragon, Wilton-road, Salisbury
1869		Hunt, Charles, 15, Victoria-street, Westminster, S.W.
1899		Hunter, Archibald Glen Kidston-, Public Analyst, 132, Princes-street, Dunedin, New Zealand
1883		Hunter, John, 37, Chambers-street, Edinburgh
1885		Hunter, Matthew, M.A.(Oxon.), Rangoon College, Rangoon, Burma
1878		Huntington, A. K., Prof., A.R.S.M., Metallurgical Laboratory, King's College, Strand, W.C.
1893	Trans.	Huntly, George Nevill, B.Sc., A.R.C.S., F.I.C., 96, Gower-street, W.C., and 56, Sheen-road, Richmond
1885		Hurst, George H., 22, Blackfriars-street, Salford
1901	Trans.	Hurtley, W. Holdsworth, D.Sc., St. Bartholomew's Hospital, E.C.
1861		Huskisson, H. O., 5, Gordon-square, London, W.C.
1900		Hutchin, H. W., Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, B.A., B.Sc., Bryn-y-Mor, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A., Ph.D., Pembroke College, Cambridge
1884		‖Hutchinson, C. Clark, 13, The Boltons, South Kensington, S.W
1901		Hutton, R. S., M.Sc., Owens College, Manchester
1903		Huyin, Moung Tha, B.A., Burma, 18, Mercers-road, N.
1901		Hyder, A. J., 22, Gunton-road, Upper Clapton, N.E.
1904		Hymans, Herbert, 13 and 14, Trinity-square, E.C.
1904		Ibbotson, Edward Charles, 3, Ashgate-road, Sheffield
1900		‖Ichioka, Tajiro, Prof., 19, Maruyama Shinmachi, Hongo, Tokyo, Japan
1888		Idris, Thomas Howell Williams, 110, Pratt-street, Camden Town, N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1889	Trans.	‖Ingle, Herbert, Government Agricultural Chemist, Pretoria, Transvaal, South Africa
1901		Ingram, Beresford, William Ellis Endowed School, Gospel Oak, N.W.
1897	Trans.	Innes, W. R., Ph.D., D.Sc., 6, Griffiths-road, Wimbledon, S.W.
1901		‖Ionides, S. A., 23, Second-avenue, Hove, Sussex
1883		‖Irwin, Wilfred, Inglehurst, Higher-lane, Stand, Manchester
1892		‖Isaac, John F. V.
1885		Ivatt, Albert, M.A., "The Engadine," Histon, Cambridge
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex
1883		‖Jackson, A. Henrick, Prof., B.Sc., The Electrical Engineering School, 349, Collins-street, Melbourne, Australia
1903		Jackson, Clements Frederick Vivian, F.G.S., Geological Survey Office, Perth, Western Australia
1894	Trans.	Jackson, David Hamilton, M.A., B.Sc., Ph.D., 47, Mecklenburg-square, W.C.

Date of Election.			
1882			Jackson, Edward, "Raven's Clift," Oxford-road, Moseley, Birmingham
1900	Trans.		Jackson, Henry, M.A., Downing College, Cambridge
1884	Trans.		Jackson, Herbert, Chemical Laboratory, King's College, Strand, W.C.
1892			Jackson, John, Llangorse Villa, Serpentine-road, Gold Tops, Newport, Mon.
1881			‖Jackson, R. Valentine, c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			Jackson, Samuel, F.I.C., c/o Messrs. Binny and Co. Madras, India
1902			Jackson, William Brannan, Glengowan, Caldercruix, N.B.
1903			Jackson, William Henry, 73, Church-street, West Hartlepool
1887			‖Jadhava, K. B., Baroda, Bombay Presidency, India
1900			Jaffé, Adolf, 8, Leyburn-grove, Shipley, Yorks.
1878	Trans.		Jago, William, F.I.C., Godrevy House, Wilbury-avenue, Hove, Sussex, and Cornwall-buildings, 35, Queen Victoria-street, E.C.
1895			James, Alfred, 2, Broad-street-place, E.C.
1878			Jamieson, Alexander, 134, Castellain-mansions, Sutherland-avenue, W.
1901			Jamieson, J. S., Government Laboratory, Durban, Natal
1879	Trans.	C.1882-5 F.S. 85-91 V.P.95-9	†‖Japp, F. R., Prof., M.A., LL.D., F.R.S., The University, Aberdeen
1902			Jardin, David Smith, Rathgar House, Rathgar, Co. Dublin
1902			Jardine, Douglas Kennedy, B.Sc. (Vict.), c/o Daily Chronicle Office, Georgetown, Demerara, British Guiana
1882			Jarmay, Gustav, Hartford Lodge, Hartford, Cheshire
1898			Jarvis, G. A., The Shrubbery, Snedshill, Wellington, Salop
1898			Jee, E. C., D.Sc., 39, Pepys-road, New Cross, S.E.
1896	Proc.		Jeffers, E. Haynes, 87, Kyrle-road, West Side, Clapham Common, S.W.
1901	Proc.		Jemmett, W. H. C., B.A., Tintern, Gap-road, Wimbledon, S.W.
1891	Trans.		Jenkins, Henry C., 5, Deerbrook-road, Herne Hill, S.E.
1904			Jenkins, Herbert, 52, Criffel-avenue, Streatham Hill, S.W.
1892			‖Jenkins, John H. B., Chemical Laboratory, G.E. Ry. Works, Stratford, E.
1894			Jenks, R. Leonard, A.C.G.I., F.I.C., 24, Baskerville-road, Wandsworth Common, S.W.
1900			Jennings, Henry, 42, Marlowes, Hemel Hempstead, Herts.
1904			Jennings, Walter Ernest, 8, Rawdon-terrace, Ashby-de-la-Zouch
1894			Jennison, Francis Herbert, 26, Derby-crescent, Kelvinside, near Glasgow
1896	Trans.		‖Jerdan, D. S., M.A., B.Sc., Ph.D., c/o Messrs. J. and G. Cox, Gorgie Mills, Edinburgh

† Longstaff Medallist, 1891.

Date of Election.		
1898		Jessop, S. M., 84, Horbury-road, Wakefield
1879		Jewson, Francis A. B., 19A, Devonshire-place, Brighton
1901		Johnson, Charles Harold, M.B., Ch.M., F.R.C.S., M.R.C.P. (Edin.), "Beaumont," Northcote, Melbourne
1895		Johnson, F. E., Holly House, Cottingham, Hull
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), The Grammar School, Gainsborough
1883		Johnson, James Edward, 40, Idmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1886		Johnson, J. T., Durham School, Durham
1897		Johnson, Otis C., Prof., 730, Thayer-street, Ann Arbor, Mich., U.S.A.
1866		‖Johnson, Samuel H., The Warren Hill, Loughton, Essex
1904		Johnston, John Haslam, M.Sc., F.I.C., Public Offices, Hampton, Middlesex
1896		Johnstone, James, Braehead, Parkhill, Rutherglen
1892		Johnstone, William George, c/o Messrs. Warwick's, The Brewery, Newark-on-Trent
1901	Trans.	Jollyman, W. H., Government Laboratory, P.O. Box 1080, Johannesburg, Transvaal, South Africa
1903		Jones, Alfred Owen, c/o Messrs. Carr & Co., Caldewgate, Carlisle
1898		Jones, Edward, B.Sc., 15, Macaulay-road, Clapham, S.W.
1871	Trans.	Jones, E. W. T., The Oaklands, Wolverhampton; and 10, Victoria-street, Wolverhampton
1873	Trans.	Jones, Francis, M.Sc., F.R.S.E., Beaufort House, Alexandra-park, Manchester
1894		‖Jones, George Cecil, Wistaria Cottage, Manningtree, Essex
1876	Trans.	‖Jones, H. Chapman, Royal Coll. of Science, S. Kensington, S.W.
1893		Jones, Hedley Gordon, 16, Greenholm-road, Eltham, S.E.
1900	Trans.	Jones, H. O., M.A., D.Sc., Clare College, Cambridge
1878		Jones, Henry Williams, Spencer-park, Coventry
1890		Jones, John Archyll, B.Sc., 2, Stanhope-avenue, West Hartlepool
1901		Jones, John Lloyd Thomas, Major, I.M.S., Byculla Club, Bombay
1892	Trans.	Jones, Lionel Manfred, Municipal Technical School, Suffolk-street, Birmingham
1899		Jones, L. W., Ph.D., University of Chicago, Chicago, Ill., U.S.A.
1891		Jones, M. William, Greystonedale, Kensington-hill, Brislington, Bristol
1896		Jones, Robert Haslewood, 88, Norwood-road, London, S.E.
1901		Jones, Robert Henry, M.Sc., The Harris Institute, Preston
1898		Jones, Thomas Hill-, Eagle Wharf-road, New North-road, N.
1893	Trans.	Jowett, Hooper Albert Dickinson, D.Sc. (Lond.), 'Wansfell,' Church-avenue, Sidcup, Kent

Date of Election.		
1891		Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900		Joyce, Thomas Goode, B.Sc. (Lond.), 41, Britannia-row, Islington, N.
1893		Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.	Kawakita, Michitada, Engineering College, Tokio, Japan
1881	Trans.	Kay, William E., Marple Lodge, Marple, Cheshire
1889		Kaye, J. R., M.B., Medical Officer of Health, West Riding of Yorkshire, Wakefield
1883		‖Keeling, Frank, Dapdune, Guildford, Surrey
1882		‖Keen, Austin, Glenbaiden, Trumpington-road, Cambridge
1894		‖Kellas, Alexander Mitchell, B.Sc., 2, St. Mark's-square, Regent's Park, N.W., and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874		Kellner, William, Ph.D., Chemical Department, Royal Arsenal, Woolwich, S.E.
1897		Kelly, Charles, The Technical School, Darwen, Lancs.
1867		‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882		‖Kemp, William Joel, Mountfield, Robertsbridge, Sussex
1903		Kemp-Welch, Maurice, B.A. (Cantab.), Parkstone, Weybridge, Surrey
1884		Kendall, George Frederic, B.A., The Hollies, Stratford-upon-Avon
1874		Kendall, James Alfred, Lonesome Chemical Works, Streatham Common, S.W.
1896		‖Kennicott, Cass L., 77, Jackson-boulevard, Chicago, U.S.A.
1903		Kent, Thomas Oliver, 89, Loughboro'-park, Brixton, S.W.
1889		Kenwood, Henry R., M.B., C.M. (Edin.), L.R.C.P. (Lond.), 9, Alexandra-villas, Finsbury Park, N.
1895		Kenyon, Richard E., M.Sc., Shebear College, Highampton, N. Devon
1903		Kerr, James Stewart, A.R.C.S., Methodist College, Belfast
1883		Kerry, William H. R., The Sycamores, Windermere
1900		Kershaw, J. H., Sewage Works, Aldwarke, Rotherham, York
1901		Kettle, J. D., 1, Vardens-road, St. John's Hill, Battersea, S.W.
1902		Kewley, James, B.A. (Cantab.), King William's College, Castletown, Isle of Man
1895		Kibble, William Oakes, F.I.C., General Post Office, Denver, Colorado, U.S.A.
1901		Kiddell, C. G., B.A., Hadley Highstone, Barnet, Herts.
1903		Kielty, John J., Nethersgate, Cairo-road, Walthamstow, Essex
1900		Kilner, G. W., M.A., 4, Melrose-villas, Church End, Finchley, N.

Date of Election.			
1884			Kilpatrick, W. Stirling, 6, Colebrook-street, Hillhead, Glasgow
1904			Kin, Thein, B.A. (Cal.), Chemical Examiner's Office, Rangoon, Lower Burma, India
1872	Trans.	C. 1887-92	‖Kinch, Edward, Prof., Royal Agricultural College, Cirencester
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1902			‖King, Frank Eustace, B.Sc., A.I.C., Woodbury, Polworth-road, Streatham, S.W.
1903			King, Frank William George, 15, Almond-road, Tottenham, N.
1897			King, Herbert, M.Sc., 8, Avenue-road, Scarborough
1876			King, J. Falconer, Laboratory of City Analyst, 20, Chambers-street, Edinburgh
1902			King, Sidney Isaac, 1, Russell-villas, Strawberry Hill, Middlesex
1895			Kingdon, G. Holman, M.A., c/o Messrs. Crosfield, Limited, Warrington, and Ivy Lodge, Froghall, Warrington
1872	Trans.		‖Kingzett, Charles T., Elmstead Knoll, Chislehurst, Kent
1899			Kinnersley, Henry Wulff, A.I.C., London County Council, 40, Craven-street, W.C.
1895			‖Kinnicut, L. P., Prof., 77, Elm-street, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	‖Kipping, F. Stanley, Prof., D.Sc., Ph.D., F.R.S., University College, Nottingham
1886			Kirby, Herbert E., St. Margaret's-mansions, Victoria-street, S.W.
1890			Kirk, Oliver, 7, Banklands, Workington
1895			‖Kirkaldy, Patrick H., Chemical Department, King's College, W.C.
1903			Kirkby, William, Winster House, Thornfield-road, Heaton Moor, Stockport
1889			Kitchin, John, The Middlesex Hospital, W.C.
1888			‖Knaggs, Alfred Battye, 2, Bradley-lane, Huddersfield
1889			Knight, Frederick Charles, Boston and Colorado Smelting Company, Argo, Colorado, U.S.A.
1904			Knight, Harley Fancut, "Ledbury," 64, Amhurst-park, Stamford Hill, N.
1894			Knight, James, M.A., D.Sc., St. James's Public School, Calton, Glasgow
1896			Knight, J. B., Bushwood, Wanstead, Essex
1894			Knight, William Albert, Sexey's Trade School, Bruton, Somerset
1878			Knights, James West, County Laboratory, Cambridge
1879			Knowles, Joshua, Stormer-hill, Tottington, Bury
1892			Knowles, Thomas Torrens, M.A. (Cantab.), 27, Peel-street, Princes Park, Liverpool
1861			Knox, G. W., B.Sc., 16, Finsbury-circus, E.C.
1873			Koch, Walter Edward, M.A., F.G.S., Lustre Mining Co., Santa Maria del Oro, Estava de Durango, viâ Parral, Mexico
1887	Trans.		Koga, Yoshimasa, The Imperial Mint, Osaka, Japan

Date of Election.			
1886	Trans.	C. 1903-	Kohn, Charles Alexander, Ph.D., M.Sc., F.I.C., Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1885			Koningh, Leonard de, F.I.C., 4, St. Martin's-road, Stockwell, S.W.
1892			Krause, G., Prof., Cöthen (Anhalt), Germany
1859	Trans.		Kynaston, Josiah W., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900			Kynaston, W. C. R., 9, Harland-road, Higher Tranmere, Birkenhead
1888			Lafosse, Charles R., 407, Oxford-street, Manchester
1903			Laing, John, 5, Scone-gardens, Piershill, Edinburgh
1893			Lamb, Edmund George, M.A., Borden Wood, Liphook, Hants.
1900			Lamb, M. C., Herold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.		‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893			Lambert, Wesley J., 55, Plumstead Common-road, Plumstead, Kent
1904			Lamplough, Francis Edward Everard, B.A. (Cantab.), Trinity College, Cambridge
1877			Lancaster, William James, F.R.A.S., F.R.C.S., F.R.M.S., Pine Crest, Barnt Green, Worcs.
1902			Landau, A. Lionel, P.O. Box 4, Standerton, Transvaal, South Africa
1900	Trans.		Lander, G. Druce, D.Sc. (Lond. and St. Andrews), F.I.C., Royal Veterinary College, Camden Town, N.W.
1886			Lang, William, Cross Park, Partick
1897	Trans.		Lang, W. R., Prof., D.Sc., F.I.C., The University, Toronto, Canada
1899			Lange, E. F. S., Fairholm, Willow Bank, Fallowfield, Manchester
1885			Langer, Charles, Ph.D., Ynyspenllwch, Clydach, R.S.O., Glamorganshire
1891			‖Langham, E. Norman, Rev., M.A. (Cantab.), F.L.S., Head Master, Rastrick Grammar School, Brighouse
1894	Trans.	C. 1904-	Lapworth, Arthur, D.Sc., The Goldsmiths' Institute, New Cross, S.E.
1901	Proc.		Larter, A. T., c/o The Dowson Economic Gas and Power Co., Ltd., Basingstoke Ironworks, Basingstoke, Hants.
1883			Lascelles, B. P., B.A., Longridge, High-street, Harrow-on-the-Hill
1880			Last, Frank B., Laboratory, 78, Mansell-terrace, Swansea
1901			Lattey, R. Tabor, Trinity College, Oxford
1891	Trans.		Lauder, Alexander, B.Sc., Edinburgh and East of Scotland College of Agriculture, 13, George-square, Edinburgh
1886	Trans.		Laurie, Arthur P., Principal, M.A., D.Sc., F.R.S.E., The Heriot-Watt College, Edinburgh

Date of Election.		
1902		Lavelle, Selwyn P. J., Royston-villa, Burton-on-Trent
1876		‖Law, Channell, Ilsham Dene, Torquay
1896		‖Law, Herbert E., 2304, Van Ness-boulevard, San Francisco, Cal., U.S.A.
1890	Trans.	‖Law, Robert, F.I.C., The Royal Mint, Melbourne, Australia
1904		Lawrence, Henry William, c/o The Agricultural and Pastoral Food Co., Ltd., Davis-street, Wellington, New Zealand
1896	Trans.	Lawrence, W. Trevor., B.A., Ph.D., Burford, Dorking; and Owens College, Manchester
1900		Laws, A. R., 22, Belgrave-terrace, Newcastle-on-Tyne
1882		Laws, J. Parry, F.I.C., 2, Aigburth-vale, Liverpool
1890	Trans.	‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890		Lea, A. Sheridan, M.A., Sc.D., F.R.S., Sunnyside, Sidcup, Kent
1886		‖Leach, Walter, 21, St. Andrew's-place, Bradford
1904		Leadbetter, Harold Duff, 95, Capel-road, Forest Gate, E.
1902		Leader, George Herbert, Montego Bay Secondary School, Montego Bay, Jamaica
1902		Leahy, A. W. D., Lieut.-Col., I.M.S., 16, St James'-square, S.W.
1894	Trans.	‖Lean, Bevan, D.Sc., B.A., Sidcot School, Winscombe, Somerset
1888		Lease, Frank E., Melapi Estate, Sandakan, British North Borneo
1902		Leather, John Petty, 17, Carlton-road, Burnley, Lancs.
1891	Trans.	Leather, J. Walter, Ph.D., F.I.C., Dehra Dun, United Provinces of Agra and Oudh, India
1900		‖Leathes, John Beresford, M.A., M.B., 89, Albert Bridge-road, S.W.
1889		Ledingham, L. Napier, Govandale, Elmore-road, Sheffield
1883		Lee, Herbert C., The Conservative Club, St James'-street, S.W.
1898		Lee, H. L., 23, Cavendish-road, Leeds
1883		Lee, Robert Brewer, B.A., B.Sc., 6, Warwick-street, Kensington, W.
1897	Trans.	Lee, T. H., Laboratorio Chemico e Industrial de Alcides Medrado and Cia., Rua de Alfandega No. 71, Caixa do Correio No. 1172, Rio de Janeiro, Brazil
1891		Leeds, Frank H., F.I.C., 26, East Bank, Stamford Hill, N.
1899		Leeming, W. T. L., M.Sc., Simon Langton School, Canterbury
1873		Lees, Charles, Devonshire House, Bridlington Quay, Yorks.
1903	Trans.	Lees, Frederic Herbert, 256, Park-road, Crouch End, N.
1891		Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889		‖Legg, John Edmund, M.A., F.I.C., near Melton Hill, Woodbridge, Suffolk
1901		Lehmann, A. L. F., B.Sc., Ph.D., Bangalore, Mysore, India
1891	Proc.	Leicester, James, Ph.D., Ivor House, Old Normanton, Derby
1903		Leigh, Arthur Graham, jun., Chorcliffe House, Chorley, Lancs.
1889		Leigh, Cecil, F.I.C., Birmingham Metal and Munitions Co., Ltd., Adderley Park Rolling Mills, Birmingham

Date of Election.			
1904			Le May, Percy Kent, 6, Lothair-villas, Hatfield, Herts.
1891			Lennox, Robert N., Morvah, Hartington-road, Chiswick, S.W.
1899			Leon, A. A., 5, Bullingham-mansions, Pitt-street, Kensington, W.
1882			Lescher, Frank Harwood, 60, Bartholomew-close, E.C., and 31, Devonshire-place, W.
1904			Lessing, Rudolf, Ph.D., c/o Gas Light and Coke Co., Tar Works, Beckton, E.
1902			Lessner, Charles B., Carril Works, The San Finx Tin Mines, Carril, Spain
1895	Trans.		Le Sueur, Henry Rondel, D.Sc. (Lond.), F.I.C., St. Thomas' Hospital, S.E.
1896	Trans.		Lethbridge, W. A., Allandale, Gerard-road, Weston-super-Mare
1899			Lett, S. J., 149, Lupus-street, S.W.
1879			Letts, Edmund Albert, Prof., D.Sc., Ph.D., Queen's College, Belfast
1903			Levy, Henry Wolff, 423B, Little Collins-street, Melbourne, Australia
1888	Trans.		Lewes, Vivian B., Prof., 19, Park-row, Greenwich, S.E.
1901			Lewis, E. A., 310, Dudley-road, Birmingham
1899	Trans.		Lewis, E. W., 64, Ommaney-road, New Cross, S.E.
1903			Lewis, Harry Percy, 9, Calvert-terrace, Swansea
1894	Trans.		Lewis, William Henry, M.A., 32, St. Leonard's-road, Exeter
1869	Trans.		‖Lewis, W. J., Prof., New Museums, Cambridge
1888	Trans.	C. 1902-03	Lewkowitsch, Julius, Ph.D., F.I.C., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, T. D., F.I.C., Chemical Works, Silvertown, E.
1896			Lidgey, C. R., Uralla, Duncombe-hill, Honor Oak Park, S.E.
1900			Liebmann, Adolf, M.A., Ph.D., 16, Darley-avenue, West Didsbury, Manchester
1903			Linday, John Howard, Y.M.C.A., Totterdown, Bristol
1901			Linde, H. T. G. van der, 101, Tyndall-avenue, Toronto, Canada
1892			Lindley, Hubert Edward, Rose Villa, Pinner-road, Harrow
1899			Lindsey, R. W., 22, Hilldrop-crescent, Camden-road, N.
1886	Trans.		Ling, Arthur R., F.I.C., Hazeldene, Kingston-road, New Malden, Surrey
1899			Linstead, E. F., 15, Station-avenue, Winchmore Hill, N.
1902			Liotard, Ernest, 2, Rue de France, Nice, France
1853	Trans.	V.P. 1883-7 1898-1901	‖Liveing, G. D., Prof., M.A., Sc.D., F.R.S., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof. M.A., LL.D., A.R.S.M., F.R.S., F.I.C., University, Sydney, New South Wales, and The Octagon, St. Mark's-road, Darling Point, Sydney
1903			Livesey, Charles Edwin Leonard, B.Sc. (Vict.), 1, Skipton-road, Colne, Lancs.

Date of Election.		
1883		Livingston, W. J., F.I.C., London County Council, Spring-gardens, S.W.
1880		‖ Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.	Lloyd, F. J., Muscovy House, 6, Trinity-square, E.C.
1893		Lloyd, Herbert, Allegheny-avenue, and 19th-street, Philadelphia, U.S.A.
1896		Lloyd, T. H., c/o Messrs. Quibell Bros., Ltd., Newark-on-Trent
1900		Lockhart, T. L., P.O. Box 231, Glencairn Main Reef Gold Mining Co., Ltd., Germiston, Transvaal, South Africa
1902		Lockitt, Charles Henry, B.A. (Lond.), 5, Harley-road, South Hampstead, N.W.
1896		Lockwood, T. W., Heckmondwike, Yorks.
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1901		Loewenthal, Oscar, Manager, Hacienda del Calvario, Zacualpan, Estado de Mexico, Mexico (viâ New York)
1903		Logan, Thomas Stratford, West Riding Asylum, Wakefield, Yorks.
1884		London, J. Edward, M.D., M.R.C.S., L.R.C.P., 62, Main-street, Georgetown, Demerara, West Indies
1872		‖ Longstaff, George Blundell, M.A., M.D. (Oxon.), F.R.C.P., M.R.C.S., Highlands, Putney Heath, S.W.
1873		‖ Loram, H. Y., 49, Buxton-road, Chingford, Essex
1878	Trans.	‖ Louis, D. A., F.I.C., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward G., Ph.D., 80, East 55th-street, New York, U.S.A.
1882		‖ Lovibond, Thomas Watson, F.I.C., Hesleyside, Bellingham, R.S.O., Northumberland
1884		Low, Charles William, M.B., Stricklands, Stowmarket, Suffolk
1904		Lowe, Frank Harold, B.Sc. (Vict.), South-Western Polytechnic, Manresa-road, Chelsea, S.W.
1878		‖ Lowe, Walter Bezant, M.A., Cae Carw, Llanfairfechan, North Wales
1876		Lowe, William Foulkes, A.R.S.M., 9 Hough-green, Chester
1898	Trans.	‖ Lowry, T. M., D.Sc., 44, Blenheim-crescent, W.
1901		Lowson, William, B.Sc., F.I.C., The University, Leeds
1899		Lucas, Alfred, Survey Department, Public Works Ministry, Cairo, Egypt
1902		Lucas, Harry, 1, St. Agnes'-place, Kennington Park, S.E.
1902	Trans.	Ludlam, Ernest Bowman, Ackworth School, Ackworth, near Pontefract, Yorks.
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, and Southville, Swansea
1877	Trans.	‖ Luff, Arthur Pearson, M.D., B.Sc. (Lond.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), 9, Queen Anne-street, Cavendish-square, W.

Date of Election.		
1890	Trans.	Lumsden, John S., D.Sc., Ph.D. (Munich), Rosewood-terrac West Park, Dundee
1867	Trans.	‖Lunge, G., Prof., Englischviertelstrasse 22, Zürich, Switzerla
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles M., D.Sc., University College, and Kenn View, Mansfield-road, Reading
1899		Luxton, Thomas, B.A., B.Sc., 28, Albany-street, Hull
1873		Lyon, I. B., Brigade Surgeon, Lieut.-Col., C.I.E., East Ind U.S. Club, 16, St. James's-square, S.W., and 164, Sutherlan avenue, W.
1874		Lyon, J. G., The Aire Tar Works, Knottingley, Yorks.
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72, Brainard-street, Detroi Mich., U.S.A.
1859		‖Lyte, F. Maxwell, M.A. (Cantab.), F.I.C., A.I.C.E., 60, Fi borough-road, South Kensington, S.W.
1888		Maben, Thomas, Kenmure, 63, Stradella-road, Herne Hill, S.E
1896		Macadam, H. E., Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson J. C. G., Analytical Laboratory, 55, Yor place, Edinburgh
1899		McAlley, James, West-drive, Irvine, N.B.
1900		Macara, Thomas, 6, Sutherland-terrace, Dowanhill, Glasgow
1890		|MacArthur, J. Stewart, 45, Renfield-street, Glasgow
1887		|McArthur, John, F.R.S.E., 196, Trinity-road, Wandswor Common, S.W.
1888		McBretney, Edmund George, F.I.C., 23, Ferrybridge-road, Castl ford, Yorks.
1900		M'Call, William, 2, Lope de Vega, Santander, Spain
1902		MacCallum, Douglas Archibald, Central-chambers, 93, Ho street, Glasgow
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1890	Trans.	McConnell, Arthur H., 73, Northern-grove, West Didsbury, ne Manchester
1904		McCourt, Cyril Douglas, A.C.G.I., 52, Victoria-road, Clapha S.W.
1875		‖McCowan, William, F.I.C., Dunedin House, Basinghall-avenu E.C.
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D., 7, Kirklee-gardens, Kelvinsid Glasgow
1895		McCreath, James, West Cornwall Creamery, Lelant, R.S.C Cornwall
1899		McCreath, W. D., Quantock Vale Cider Co., Ltd., Nor Petherton, Bridgwater

Date of Election.		
1890		McCubbin, William A., 35, The Temple, Dale-street, Liverpool
1897		MacCulloch, Charles, Princes-street, Auckland, New Zealand
1894		McCutcheon, James, 21, Braidburn-crescent, Edinburgh
1903		Macdonald, David Baird, 18, Kimberley-road, Leicester
1901		Macdonald, F. G., Cyanide Manager, Durban Roodeport Gold Mining Co., Ltd., P.O. Box 111, Roodeport, Transvaal, S. Africa
1894	Trans.	MacDonald, G. W., M.Sc., c/o Messrs. Curtis and Harvey, Ltd., Dartford, Kent
1901		Macdonald, P. E., c/o The Mazapil Copper Co., Ltd., Concepcion del Oro, Zacatecas, Mexico
1891		MacDonald, William G., c/o Dr. C. C. Stuhlmann, Tung Wen Kwan, Peking
1874		McDougall, John, Clifton House, Greenwich Park, S.E.
1886		MacEwan, Peter, 64, Southwood-lane, Highgate, N.
1898		McEwen, A. F., 1, Northbrook-road, Lee, S.E.
1895		MacFarlane, Alexander, 43, Filey-road, Fallowfield, Manchester
1891		Macfie, R. A. Scott, M.A. (Cantab.), B.Sc., 34, Moorfields, Liverpool
1895		McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.	McGowan, George, Ph.D., 21, Montpelier-road, Ealing, W.
1893		McGregory, Joseph Frank, Prof., Colgate University, Hamilton, New York, U.S.A.
1890		Macintyre, Alfred E., The Chemical Laboratory, Dominion Arsenal, Quebec, Canada
1877		Mackay, Angus, 450, Darling-street, Balmain, Sydney, N.S.W.
1890		Mackean, William, c/o Welsbach Incandescent Gas Light Co., Ltd., Broomhill-road, Wandsworth, S.W.
1901	Trans.	McKenzie, Alexander, M.A., D.Sc., Ph.D., Chemical Department, The University, Birmingham
1900		McKenzie, Alexander Ernest, 11, Bank-road, Workington
1897	Trans.	Mackenzie, John Edward, D.Sc., Ph.D., Birkbeck College, Bream's Buildings, E.C.
1902		Mackenzie, John Ross, The Worcester Brewery, Worcester
1899		Mackenzie, Thomas, 4, Church-street, Inverness
1900		Mackenzie, T. E., The Capillitas Copper Co., Ltd., Pilciao, Provincia de Catamarca, Argentine Republic, S. America
1892		Mackenzie, William Cossar, D.Sc. (Edin.), Tewfikieh College of Agriculture, Gheezeh, Cairo
1893		McKerrow, Charles Alexander, 8, Exchange-street, Manchester
1892		McKerrow, William James, D.Sc., c/o Messrs. Field and Co., Upper Marsh, Lambeth, S.W.
1902		Macknight, Alexander, 128, Blackburn-road, Clayton-le-Moors, Lancs.
1901		McLaren, Daniel, Brookdale, Grey-street, Stalybridge
1897	Trans.	Maclaurin, J. S., D.Sc., Wellington, New Zealand

Date of Election.			
1868	Trans.	C. 1871-4 80-4, 87-90 95-9. V.P. 1887-90, 1901-04	‖McLeod, Herbert, Prof., F.R.S., 9, Coverdale, Montague-road, Richmond, Surrey
1899			MacLeod, James, West Hill, Cardross-road, Dumbarton
1904			McMahon, Frederick William, 8, Niederwald-road, Sydenham, S.E.
1879			‖Macmillan, J. Laker, 11, Bond-street, Sydney, N.S.W.
1897			Macmullen, Alan, B.A., 82, James-street, Dublin
1881			MacMunn, Charles A., M.A., M.D., F.R.M.S., Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, Wallaroo Smelting Works, Wallaroo, S. Australia.
1880			Macnab, William, 10, Cromwell-crescent, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D., B.Sc., 67, Braid-avenue, Edinburgh
1900			McNair, Hugh, Bellfield, Wishaw, N.B.
1899			Main, Hugh, B.Sc., "Almondale," Buckingham-road, Soutl Woodford, N.E.
1900			Mair, William, 7, Comiston-road, Edinburgh
1902	Trans.		Maitland, William, B.Sc., Chemisches Institut, Universität, Breslau, Germany
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1894			Makin, Charles James Shaw, F.I.C., Thorn Bank, Leamington
1885	Trans.		‖Mallet, Frederic Richard, F.I.C., 20, King's-avenue, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, J. W., Prof., Ph.D., M.D., F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, W. L., Gawthorp-green, Kirkheaton, near Huddersfiel
1904			Mander, Alfred, Berkswell, Malvern
1903			Mander, Percy George, B.Sc. (Lond.), The School House, Ashby de-la-Zouch
1903			Mann, Ernest William, "Lyndale," Northfield-road, King' Norton, Birmingham
1903			Mann, John Christopher, 9, Lambert-street, Hull
1903			Mann, William, B.Sc. (Lond.), 59, Blackheath-road, Greenwich, S.E.
1896			Manners, Hugh, M.A., B.Sc., Academy House, Airdrie, N.B.
1897			Mansford, C. J., B.A., The Grammar School, Dartford, Kent
1895			‖Marchant, Robert Charles, 18, Elliston-road, Clifton, Bristol
1896			Marks, E. Seaborn, c/o David Marks, Esq., 23, Palace Gate S.W.
1895			Marsden, Prosper H., The Royal Infirmary, Liverpool
1881			‖Marsh, Charles W., Ph.D.
1903			Marsh, John, 29, High-street, Maidstone

Date of Election.			
1883	Trans.	C. 1902-	‖Marsh, J. E., M.A., University Museum, Oxford
1895			Marshall, Arthur, F.I.C., Hope Cottage, Church-hill, Loughton
1890	Trans.		Marshall, Hugh, D.Sc., F.R.S., F.R.S.E., 12, Lonsdale-terrace, Edinburgh
1896			Marshall, P. S., Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, 57, Maplethorp-road, Thornton Heath, S.E.
1890	Trans.		Marshall, T. Rhymer, D.Sc., Room 713, Salisbury House, London Wall, E.C.
1888	Trans.		Marshall, William, B.Sc., Barkley, Teddington, Middlesex
1887			Marshall, William, F.I.C., Carisbrook, Queen's-road, Cheadle Hulme, Cheshire
1897			Martin, C. H., 14, Aldred-street, Crescent, Salford
1902			Martin, Francis, 3, York-villas, Cantwell-road, Woolwich, S.E.
1898	Trans.		‖Martin, G. H., M.A., 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Gerald Ward, Lieut.-Col., F.R.G.S., 8, Petersham-terrace, Gloucester-road, S.W.
1901			Martin, N. H., Ravenswood, Low Fell, Gateshead-on-Tyne
1883			Martin, W. H., 183, King's-road, Chelsea, S.W.
1902			Martindale, William Harrison, 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C., and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Northwood, Rydal-road, Streatham, S.W.
1898			Mascarenhas, J. C., Lisbon House, 54, Percy-road, Upton Park, E.
1851	Trans.	C. 1858-9, 75-7. V.P. 78-81	Maskelyne, Nevil Story, M.A., F.R.S., Salthrop, Wroughton, Wilts.
1890			Mason, Francis H., Queen-buildings, Hollis-street, Halifax Nova Scotia
1858			‖Mason, James, Eynsham Hall, Witney
1889			Mason, James Braik, The West End Laboratory, Dundee
1882	Trans.		Masson, David Orme, Prof., M.A., D.Sc., F.R.S., The University of Melbourne, Victoria, Australia
1897			Masters, Edward, 53, Dulverton-road, Leicester
1873			‖Masters, William, St. Erme, Moorend Park-road, Cheltenham
1896			Mathieson, L. W., 1, Rosebery-road, New Brompton, R.S.O., Kent
1902			Mathieson, R., J.P., Rill Bank, Innerleithen, Peeblesshire
1876	Trans.		‖Matthews, C. G., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1880	Trans.		‖Matthews, Francis Edward, Ph.D., F.I.C., Cooper's Hill, Englefield Green, Surrey
1884			‖Matthey, Edward, 78, Hatton-garden, E.C.
1870		C. 1877-9	Matthey, George, F.R.S., 78, Hatton-garden, E.C.
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.

Date of Election.			
1865			‖Maxwell, Theodore, B.A., M.D. (Cantab.), F.R.C.S. (Edin.), B.Sc. (Lond.), 29, Woolwich Common, S.E.
1896			Mayfield, A. S., 14, Beresford-avenue, Newland, Hull
1892			Meacham, Charles Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, South Africa
1898			Meads, C. J., Bel Air, Dartmouth, Devon
1904			Mears, Francis D'Oyley, jun., 4, Nyanza-terrace, Swansea
1901			Mees, C. E. K., Ryelands, Caterham, Surrey
1896			Meggitt, Loxley, c/o C.W.S., Ltd., Wheatsheaf Works, Alexandriva, Sydney, N.S.W.
1871	Trans.	C. 1883-7, 90-91 F.S. 1891-1902 V.P. 1902–	‖Meldola, Raphael, Prof., F.R.S., 6, Brunswick-square, W.C.
1895			Meldrum, Robert, Glynwood, 37, Foyle-road, Blackheath, S.E.
1894			Melland, Godfrey, M.Sc., A.R.S.M., F.I.C., Chemical Department, The Polytechnic, Woolwich, S.E.
1902	Trans.		Mellor, Joseph William, 33B, London-road, Newcastle-under-Lyme, Staffs.
1875			Melmore, Pattinson B., Chemical Laboratory, Maryport
1902			Mence, George Augustus Henry, B.Sc., Borden School, Sittingbourne, Kent
1900	Proc.		Menzies, Alan W. Cranbrook, Prof., M.A., B.Sc., St. Mungo's College, Castle-street, Glasgow
1901			Menzies, James, 39, Winterbrook-road, Herne Hill, S.E.
1884			Mercer, Francis M., 89, Bishopsgate-street-within, E.C.
1889			Mercer, Thomas, The Lion Brewery, Eastbourne
1901			Meredith, William, 63, Albion-place, Ulverston, Lancs.
1896			Merrett, W. H., Hatherley, Grosvenor-road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland-park, Sheffield
1897			Merson, G. F., 24, Newgate-street, Newcastle-on-Tyne
1876	Trans.	C. 1884-8, 1897-1901	‖Messel, Rudolph, Ph.D., 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans, Ph.D., 1, Salmgasse, Prague, Bohemia
1904			Middleditch, Bernard, B.A. (Cantab.), Woodcroft, Harrow-on-the-Hill
1888	Trans.	V.P. 1901-04	‖Miers, Henry A., Prof., M.A., D.Sc., F.G.S., F.R.S., Magdalen College, Oxford
1892	Trans.		Millar, James Hill, The Laboratory, St. James' Gate Brewery, Dublin
1843			‖Millar, James.
1891			‖Millard, Edgar J., F.R.M.S., Elyne House, Elyne-road, Stroud Green, N.
1880	Trans.		‖Miller, A. K., Ph.D., Kilvert's-buildings, With-grove, Manchester

Date of Election.			
1897			Miller, Edmund H., M.A., Ph.D., Columbia University, New York City, U.S.A.
1902			Miller, Edward Holl, 81, Chardmore-road, Stoke Newington, N.
1889			Miller, Harry East, Ph.D., 1015, Chestnut-street, Oakland, California, U.S.A.
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc., Ph.D., 44 & 45, Lewis Block, Buffalo, New York, U.S.A.
1885	Trans.		‖Miller, Norman Harry John, Ph.D., F.I.C., Harpenden, Herts.
1898			Miller, W. Lash, B.A., Ph.D., 50, St. Alban-street, Toronto, Canada
1896			Miller, W. M., Caledonia Estate, Wellesley Province, Penang, Straits Settlements
1903	Proc.		Millington, John Price, B.A. (Cantab.), B.Sc. (Wales), 65, Torrington-square, W.C.
1893	Trans.		‖Mills, Charles, The Maples, 188, Bedford-hill, Balham, S.W.
1862	Trans.	C. 1868-72, 75-6, 80-4, 1903-	‖Mills, Edmund James, Prof., D.Sc., LL.D., F.R.S., F.I.C., 64, Twyford-avenue, West Acton, W.
1898	Trans.		Mills, W. H., M.A. (Cantab.), Sc.D. (Tübingen), The Northern Polytechnic Institute, Holloway, N.
1885			‖Milne, Alexander, Major I.M.S., M.A., M.B., H.M.'s Mint, Bombay, India
1887			Mingaye, John C. H., F.I.C., Department of Mines, Assay Branch, Sydney, N.S.W.
1898			‖Mitchell, A. H., B.Sc., F.I.C., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1891	Proc.		Mitchell, Charles Ainsworth, M.A. (Oxon.), c/o Messrs. Beaufoy and Co., South Lambeth-road, S.W.
1897			Mitchell, Tom, Cemetery House, Shaw, near Oldham
1899			Mohr, Bernard, Ph.D., 69A, Parliament Hill, Hampstead, N.W.
1901	Trans.		Moir, James, M.A., D.Sc., P.O. Box 6024, Johannesburg, Transvaal, South Africa
1893			Mole, H. Bloome, Hill Side, Shepton Mallet
1902			Molesworth, Francis Hylton, 46, West-street, North Sydney, N.S.W.
1899			Molson, J. Cavendish, M.D., L.R.C.P., F.R.G.S., 1, Pavilion-buildings, Brighton
1872	Trans.	C.1885-6 V.P.87-90, 94-8	‖Mond, Ludwig, D.Sc., Ph.D., F.R.S., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A., F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.

Date of Election.			
1879			‖Mondy, Edmund F., "Dacca," 96, Huron-road, Balham, S.W.
1903			Monier-Williams, Gordon Wickham, Goethe Strasse 22, Freiburg, Germany
1904			Montgomery, Jack Percival, Ph.D. (Va.), A.B. (Clarkesville), Agricultural College, Starkville, Miss., U.S.A.
1887	Trans.	C. 1899-1900	‖Moody, G. Tattersall, D.Sc., Lorne House, North Dulwich, S.E
1902			Moody, James Butler, 111, Manchester-road, Burnley
1897			Moon, P. G. G., The Laboratory, British Gas Light Co., Ltd. Norwich
1892			‖Moor, Cresacre George, M.A., 4, Dane's Inn, Strand, W.C.
1903			Moore, Alfred Ernest, B.A., B.Sc. (Lond.), Escuela Norma Regional, Corrientes, Argentine Republic
1903			Moore, Arthur, 3, Carlisle-road, Manor Park, E.
1891			Moore, Frederick Herbert, Strada degli Argentieri, 19, Messina Sicily
1902			Moore, Thomas Henry, 9, Victoria-road, Stockton Heath Warrington
1904	Trans.		Moore, Tom Sidney, B.A. (Oxon.), B.Sc. (Lond.), Th University, Birmingham
1895			Morgan, D. J., 61, Elgin Mansions, Maida Vale, W.
1897			Morgan, F. Filmer de, 4, Orchard-house, County Grov Camberwell, S.E.
1898	Trans.		‖Morgan, G. T., D.Sc., Royal College of Science, South Kensington, S.W., and 15, Fawcett-street, Redcliffe-gardens, S.W.
1888			‖Morgan, John James, The Laboratory, Messrs. Cammell, Lai and Co., Ltd., Workington, Cumberland
1900			Morgan, J. Livingston R., M.A., Ph.D., B.Sc., Adjunct Profess of Physical Chemistry, Columbia University, N.Y., U.S.A.
1893			Morgan, J. R., The County School, Ebbw Vale, Mon.
1880	Trans.		Moritz, Edward R., Ph.D., 45, Great Tower-street, E.C.
1879	Trans.	C. 87-90 96-1900	‖Morley, H. Forster, M.A., D.Sc., 5, Lyndhurst-road, Sout Hampstead, N.W.
1895	Trans.		Morrell, R. S., M.A., Ph.D., Gonville and Caius College, Ca bridge
1892			Morris, Albert, B.Sc., Fern Bank, Dukinfield
1900			Morris, E. F., M.A., Grey House, Barrington-road, Altrincha Cheshire
1891			Morris, Joseph, Ph.D., Fern Bank, 8, Boardman-street, Eccl Manchester
1851			Morson, Thomas, c/o Messrs. T. Morson and Son, Chemic Works, Ponders End, N.
1872			Morton, Edward Handfield, 88, Wigmore-street, W.
1893			Morton, Frederick, Chemical Works, Milnsbridge, Huddersfiel

Date of Election.			
1890	Trans.		Mosenthal, Henry de, 220, Winchester-house, Old Broad-street, E.C.
1896			Moss, Frank A., Kalgurli Gold Mines, Ltd, Kalgoorlie, Western Australia
1871			‖Moss, Richard J., F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, W. E., 35, Princes-avenue, Liverpool
1886			Moul, Frank, Aldersgate Chemical Works, Southall
1884			‖Moyle, R. E., M.A., Heightley, Chudleigh, South Devon
1902			Müller, C., 9, Baronsfield-road, East Twickenham, Middlesex
1859	Trans.	C. 1863-6 F.S. 69 85 P. 85-7	‖Müller, Hugo, Ph.D., LL.D., F.R.S., 13, Park-square East, Regent's Park, N.W.
1896			Muir, J. Stanley, B.Sc., 8, Westminster-gardens, Hillhead, Glasgow
1871	Trans.	C. 1890-4	Muir, M. M. Pattison, M.A., Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc., The Lodge, Shortlands, Kent
1903			Mukerjee, Beni Madhav, B.A., Thomason College, Roorkee India
1893	Proc.		Munby, Alan E., 7, Chalcot-crescent, Primrose Hill, N.W.
1902			Mundey, Alfred H., 14, Wrottesley-road, Plumstead, Kent
1871			‖Munro, Donald, M.D., C.M., D.P.H., Medico-Legal Department, The University, Glasgow
1876	Trans.		Munro, J. M. H., D.Sc., M.R.C.S., L.R.C.P., 5, Duke-street, Bath
1888			Munroe, Charles E., Prof., Columbian University, Washington, D.C., U.S.A.
1900			Munton, F. T., Beaconsfield, Western-road, Runcorn, Cheshire
1901			Murphy, A. J., 11, Lyddon-terrace, Leeds
1904			Murray, Benjamin L., B.S., 19, University-place, New York, U.S.A.
1893			Murray, J. Alan, B.Sc., 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894			Murray, John Moore, M.Sc. (Vict.), 11, Winmarleigh-street, Warrington
1890	Trans.		‖Murray, Thomas Smith, D.Sc., 1, Nelson-street, Dundee
1869			‖Muspratt, E. K., Seaforth Hall, near Liverpool
1873			‖Muspratt, Sidney Knowles, 9, Church-street, Flint, North Wales
1896			Muter, A. H. M., F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1870	Trans.		‖Muter, John, Ph.D., F.R.S.E., F.I.C., Laboratory, 325, Kennington-road, London, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.		Myers, William Shields, M.Sc., Associate Prof. of Chemistry, Rutger's College, 15, Union-street, New Brunswick, N.J., U.S.A.

Date of Election.		
1887		Nagel, David Henry, M.A., Trinity College, Oxford
1903		Nairne, Urban Orlando Scotchburn, 7, Hawthorne-terrace, Ripple-road, Barking, Essex
1899		Nance, J. Trengove, B.A., School House, Bromsgrove, Worcs.
1874		‖Napier, Arthur S., Prof., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinandstrasse, Berlin
1893		Napier, John Watson, Corporation Gas Works, Alloa, N.B.
1900	Proc.	Napper, Sidney Scrivener, 144, Highbury New Park, N.
1898		Nash, L. M., F.I.C., 281, Seven Sisters-road, Finsbury Park, N.
1900		Naylor, E. Brooks, M.Sc., 73, Castle-street, Bolton
1891		Naylor, William, 3, Garstang-road, Fulwood Park, Preston
1878	Trans.	Naylor, W. A. H., F.I.C., 38, Southwark-street, S.E.
1899	Trans.	Neale, H. A., Vernon, British Columbia
1898		Neilson, A. M., c/o Messrs. Arthur May & Co., Durban, Natal
1901		Neumann, Edgar, B.A., Ph.D., 7 & 8, Idol-lane, E.C.
1878	Trans.	‖Nevile, R. H. C., Wellingore Hall, Lincoln
1871	Trans.	Nevill, Edmund Neville, Government Laboratory, Durban, Natal
1890	Trans.	Neville, Francis Henry, M.A., F.R.S., Sidney College, Cambridge
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, Balliol College Laboratory, Oxford
1901		Newbould, Herbert Simpson, 2, Clyde-road, West Didsbury, Manchester
1864		‖Newlands, B. E. R., F.I.C., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William P. R., 232, Amesbury-avenue, Streatham Hill, S.W.
1889		Newsholme, G. T. Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, G. S., Royal College of Science, South Kensington, S.W.
1895		Newton, Charles Butterworth, Gas Works, Carlisle
1883		Newton, William, Ph.D., F.I.C., 39, Mincing-lane, E.C.
1899	Proc.	Nichells, W. W. S., B.Sc., 230, Brockley-road, Brockley, S.E.
1870	Trans.	‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., M.R.C.S., L.S.A., D.P.H., F.I.C., 1, Huskisson-street, Liverpool
1889		Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892		Nickolls, J. Bate, The Laboratory, Guernsey
1883	Trans.	Nicol, W. W. J., M.A., D.Sc. (Edin.), 15, Blacket-place, Edinburgh
1900		Nightingale, T. M., B.Sc., 375, Bridgman-street, Bolton
1898		Nightscales, T. A., 13, Spring-street, Hull
1894		Nixon, Alfred, 7, Oak-road, Sale, Manchester
1869		Noble, Sir Andrew, Bart., K.C.B., D.C.L., F.R.S., Jesmond Dene House, Newcastle-on-Tyne
1903	Trans.	Norman, George Marshall, B.Sc. (Lond.), A.R.C.S., A.I.C., 2, Bartholomews, Brighton
1889		Norman, John T., Avalon, Putney Common, S.W.
1861		Norrington, Frederick, 5, Downfield-road, Clifton, Bristol

Date of Election.			
1892			Norris, Charles James, 31, Airedale-avenue, Chiswick, W.
1897	Trans.		North, Barker, Glenholme, Glenholme-road, Manningham, Bradford
1899			Northall-Laurie, Dudley, King's College, Strand, W.C.
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, T. H., Prof., Ph.D., D.Sc., c/o The John Crerar Library, Chicago, Ill., U.S.A.
1901			Nunn, A. W., 68, Catford Hill, S.E.
1904			Oakden, William Edward, 2, Gledhow-terrace, South Kensington, S.W.
1893	Trans.		Oates, William Henry, Broomhall Park, Sheffield
1903			O'Brien, Frederick, 9, Elvaston-road, Victoria-park, Bedminster, Bristol
1902			O'Connor, Sinnott Valentine, 14, Selskar-street, Wexford
1890			Oddy, Robert Walter, Waterhouse, Toad-lane, Rochdale
1873			‖Odling, Walter, Askew House, Repton; and Messrs. Bass and Co., Burton-on-Trent
1848	Trans.	S. 1856-69 V.P. 1869-73, P. 1873-5	Odling, William, Prof., M.A. M.B., F.R.C.P., F.R.S., 15, Norham-gardens, Oxford
1902			Ogilvie, Allan, 10, Clarke-street, Scunthorpe, near Doncaster
1901			Oldershaw, William, Strelley, Nottingham
1904			Oldfield, Laurel Cecil Francis, Lincoln College, Oxford
1889			O'Mahony, D. J., Municipal-buildings, Anglesea-street, Cork
1901			Oram, Frank, Market-place, Romsey
1890	Trans.		Ormandy, William Reginald, Gamble Institute, St. Helens, Lancs.
1869			‖Orme, Temple A., University College, W.C.; and 213, Uxbridge-road, W.
1872			‖Ormerod, Joseph Arderne, M.D., M.R.C.S., F.R.C.P., The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887			‖Ormiston, Archibald R., Bracholm, Helensburgh; and 203, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, N.S.W.
1881			Orr, John Bryson, Chestnut Lodge, Widnes, Lancs.
1884	Proc.		Orsman, W. J., jun., Chemical Laboratory, Gathurst, near Wigan
1897	Trans.		Orton, K. J. P., Prof., M.A., Ph.D., Llwyn Eithin, and University College of North Wales, Bangor
1881	Trans.		O'Shea, L. Trant, B.Sc., c/o Mrs. O'Shea, The Cottage, East Cosham, Hants.
1887			Ostersetzer, Julius, c/o Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin

Date of Election.			
1876	Trans.	C. 1882-6 V.P. 93-6	†O'Sullivan, C., F.R.S., 148, High-street, Burton-on-Trent
1883	Trans.		O'Sullivan, James, High Bank, Burton-on-Trent
1899			O'Sullivan, John, 1461, Georgia-street, Vancouver City, B.C.
1887			‖O'Sullivan, Patrick T., M.B., B.C.L., 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto C. J. G. L., Chantry House, Great Grimsby
1887			‖Overend, Frederick Lawrence, B.A. (Oxon.), 98, Rowley-street, Walsall
1871	Trans.	C. 1889-94	‖Page, Frederick James Montague, B.Sc., A.R.S.M., F.I.C., 54, Sutherland-street, Pimlico, S.W.
1904			Page, William Davidge, Hotel Russell, Russell Square, W.C.
1898	Trans.		Pakes, W. C. C., The Government Laboratories, P.O. Box 1080, Johannesburg, South Africa
1884			‖Pallister, J. W., B.Sc., 107, Waverley-road, Bradford
1882			Palmer, Alfred Neobard, Inglo Nook, Bersham-road, Wrexham
1888			Palmer, Henry John, Summerleaze, Yelverton, R.S.O., Devon
1899			Palmer, T. H., "Amalfi," Longueville, Sydney, N.S.W.
1879			Palmer, Walter, M.P., The College, Reading, and 50, Grosvenor-square, W.
1902			Panisset, Sydney Glyde Stephen, 3, Weston-road, Strood, Kent
1899	Trans.		Panting, L. C., M.A., M.D. (Oxon.), 45, Lemon-street, Truro
1900			Pardy, Alexander, The Government Laboratory, Berea, Durban, Natal, South Africa
1898			Parker, A. J., 43, Harcourt-street, Blackburn, Lancs.
1897			Parker, C. H., 13, Clark-street, Wolverhampton
1882			Parker, Joseph R., Avondale, 129, Kyverdale-road, Stoke Newington, N.
1894	Trans.		Parker, Matthew A., Prof., B.Sc., University of Manitoba, Winnipeg, Canada
1882			‖Parker, R. H., 35, Clifton-road, Maida Vale, W.
1901			Parkes, Albert E, Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890			Parkes, Thomas, M.A., 2, Gawber-road, Barnsley
1865	Trans.		‖Parkinson, James, F.G.S., Queen's-chambers, Pirie-street Adelaide, South Australia
1893			Parrish, S., 80, Grange-avenue, Chapeltown-road, Leeds
1892			Parry, Ernest John, B.Sc., 208, High-street, Borough, S.E.
1903			Parry, George Harry, The Level, Brierley Hill, Staffs.
1904			Parry, William, B.Sc. (Lond.), 31, Mount Pleasant, Waterloo, Liverpool
1870			Patchett, Isaac, F.I.C., 11, Osborne-terrace, Field Hill, Batley

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† Longstaff Medallist, 1884.

Date of Election.			
1894	Trans.		Paterson, David, F.R.S.E., Lea Bank, Rosslyn, Midlothian, N.B.
1900			Patrick, D. H., A.I.E.E., Bablake School of Science, Coventry
1885	Trans.		Patterson, George, The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, J. W., 14, Mitchell-street, W. Hartlepool, Durham
1870	Trans.		Patterson, T. L., Maybank, Finnart-street, Greenock
1904	Trans.		Patterson, Thomas Stewart, Ph.D. (Heidelberg), Lyddon Hall, Leeds
1863	Trans.	V.P. 1891-4	Pattinson, John, 10, Dean-street, Newcastle-on-Tyne
1868	Trans.		‖Paul, B. H., Ph.D., Analytical Laboratory, 13, Fenchurch-street, E.C., and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D., Market Hall-chambers, King-street, Huddersfield
1901			Pay, Walter Herbert, Government Laboratory, Durban, Natal
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Moseley-street, Newcastle-on-Tyne
1893			Payne, George F., M.D., 43½, Whitehall-street, Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley J., 240, Moss-lane East, Moss Side, Manchester
1901			Peacock, Arthur, B.Sc., Smithies-bridge House, Heckmondwike, Yorks.
1900			Pearce, E. V., The Hollies, Hayle, Cornwall
1874			Pearce, William, Chemical Works, Bow Common, E.
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1902			Peck, John Wicliffe, 28, West Ella-road, Harlesden, N.W.
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.		‖Pedler, Alexander, Prof., C.I.E., F.R.S., F.I.C., Director of Public Instruction, Writer's-buildings, Calcutta, India
1904			Pell, Alfred, 44, Cumballa-hill, Bombay, India
1886	Proc.		Pendlebury, William Henry, M.A., Woodford House, Mountfield, Shrewsbury
1870			Penney, M. D., 11, High-street, Hull
1895			Pennington, W. H., Field House, Rochdale
1886			Pentecost, Stephen James, Nottingham-road, New Basford, Notts.
1889	Trans.		Percival, John, M.A., The University College, Reading
1884	Trans.		Perkin, A. G., F.R.S., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick M., Ph.D., Borough Polytechnic, Borough-road, S.E.
1856	Trans.	C. 1861-2 1868-9 S. 1869-83 P. 1883-5	†‖Perkin, William Henry, LL.D., Ph.D., D.Sc., F.R.S., The Chestnuts, Sudbury, Harrow
1884	Trans.	C. 1891-5	*Perkin, William Henry, jun., Prof., Ph.D., F.R.S., Fairview, Wilbraham-road, Fallowfield, Manchester

† Longstaff Medallist, 1888.

* Longstaff Medallist, 1900.

Date of Election			
1890	Trans.		‖Perman, Edgar Philip, D.Sc., University College, Cardiff
1888			Perry, George Edward, 103, Stirling-road, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Mosley-street, Manchester
1903			Phelps, John, B.A. (Oxon.), Woodville, Shortlands, Kent
1881			Philip, Arnold, A.R.S.M., B.Sc. (Lond.), F.I.C., Chemical Laboratory, H.M. Dockyard, Portsmouth
1897	Trans.		Philip, J. C., B.Sc., Ph.D., Royal College of Science, South Kensington, S.W.
1887			Phillips, Arthur Gaved, A.R.S.M., F.I.C., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1889			Phillips, Benjamin, 5, Staunton-road, Poona, India
1897			Phillips, H. E. W., B.A., The Laurels, Eynsham, Oxford
1882			Phillips, Henry Harcourt, Lynwood, Turton, Lancs.
1902	Trans.		Phillips, Percy Philip, Ph.D., Thomason Engineering College, Rurki, North-West Provinces, India
1900			Phillpotts, G. Surtees, 82, James-street, Dublin
1897	Trans.		‖Pickard, Robert Howson, D.Sc., Ph.D., F.I.C., Municipal Technical School, Blackburn
1891			Pickering, M. Samuel, B.Sc. (Lond.), 38, Price-street, Burslem
1878	Trans.	C.1886-7 89-93 1901-04	‖Pickering, Spencer Percival Umfreville, M.A., F.R.S., Harpenden, Herts.
1890	Trans.		‖Picton, Harold, B.Sc., Clacton College, Clacton-on-Sea
1894			Pike, E. Brooke, Grasmere, 515, Romford-road, Forest Gate, E.
1904			Pike, Henry George, College of Agriculture, Downton, Salisbury, Wilts.
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D., Sandhills, Salcombe, Kingsbridge, Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, T. W., 33, Grove-hill-road, Denmark Hill, S.E.
1904			Pinchbeck, Gerald, 96, Albany-street, Regent's Park, N.W.
1889			Ping, William, 16, Forest-drive West, Leytonstone, E.
1889			Pingstone, G. Arthur, Bulawayo Public Analyst, P.O. Box 445, Bulawayo, South Africa
1904			Pinkerton, David John, Dalzell Steel and Iron Works, Motherwell, N.B.
1881			Pisani, O. V., Effingham House, Arundel-street, Strand, W.C.
1903	Trans.		Pitt, Arthur Ernest, 66, Abbott-road, Bromley, E.
1903			Pitt, Harold Russell, 8, Church-lane, Charlton, S.E.
1882			Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, F. W., St. Nicholas' Buildings West, Newcastle-on-Tyne
1899			Pizey, J. H., Anchor Chemical Works, Provanmill, Glasgow

Date of Election			
1893			Platt, Charles, M.D., Ph.D., Hahnemann Medical College, Philadelphia, U.S.A.
1860			‖Player, J. H., 16, Prince Arthur-road, Hampstead, N.W.
1899	Trans.		‖Plimmer, R. H. Aders, 16, Cheyne-walk, Chelsea, S.W.
1903			Plymen, George Horace Gladstone, The Bulwarks, St. Aubyn, Jersey
1899			Polkinghorne, B. C., B.Sc., 17, Humber-road, Blackheath, S.E.
1888			Pollard, F. Ernest, 14, Old Hall-street, Hertford
1898	Trans.		Pollard, William, B.A., Ph.D., The Museum, Jermyn-street, S.W.
1904			‖Pollard, William Branch, B.A. (Cantab.), 21, Ravensbourn-gardens, Ealing, W.
1902			Pollitt, George Paton, B.Sc., Ph.D., Ivy Walls, Stanford-le-Hope, Essex
1901			Pollitt, J. C. T., c/o Messrs. Kynoch, Ltd., Witton, near Birmingham
1896			Pollitt, R. B., c/o The De Beers Explosive Works, Cape Town, South Africa
1897			Pollitt, Samuel, B.Sc., The Polytechnic, South Tottenham, N.
1894	Trans.		‖Pollok, J. Holms, B.Sc., Royal College of Science, Stephen's-green, Dublin
1903			Pond, George Gilbert, Prof., M.A., Ph.D. (Amherst), Pennsylvania State College, Pennsylvania, U.S.A.
1890			Pond, James Alexander, Auckland, New Zealand
1899			Ponthien, Georges, c/o Messrs. Parke, Davis & Co., Detroit, Mich., U.S.A.
1848			Pontifex, Edmund A., M.I.C.E., 6, Cadogan-court-gardens, Cadogan-place, S.W.
1862			Pooley, Thomas A., B.Sc., F.I.C., Beverley, Hersham-road, Walton-on-Thames, Surrey
1898	Trans.		Pope, T. H., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	†Pope, William Jackson, Prof., F.R.S., F.I.C., 16, Hope-street, Higher Broughton, Manchester
1903			Porter, Robert James, 11, Arlington-street, Hull
1884	Proc.		‖Porter, T. Cunningham, Rev., M.A., Eton College, Windsor
1904			Porter, Thomas Linton Daniel, 161, Downsell-road, Stratford New Town, E.
1895			Potter, Arthur E., M.A. (Cantab.), B.Sc. (Lond.), Rangoon, Burma, India
1883			Potter, Charles Edward, c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland S., 97, Belgrave-road, Cranbrook-park, Ilford, E.
1896			Potts, H. W., Hawkesbury Agricultural College, Richmond, N.S.W.

† Longstaff Medallist, 1903.

Date of Election.			
1895			Powell, H. James, 530, Lordship-lane, S.E.
1901			Powell, John, Balliol House, Wentworth-street, E.
1896	Trans.		Power, F. B., Ph.D., 6, King-street, Snow-hill, E.C.
1884			‖Power, Francis R., The Royal Mint, Melbourne, Australia
1902			Powney, William E. F., 9, Lancaster-road, Stroud Green, N.
1903			Prasad, Mata, M.A. (Allahabad), Beni lals Katra, Benares City, India
1904	Trans.		Prentice, Bertram, Ph.D. (Munich), D.Sc. (Edin.), Roya Technical Institute, Salford
1876	Trans.		Prescott, Albert B., Prof., M.D., University, Ann Arbor, Michigan, U.S.A.
1902			Přibram, Richard, Prof., University of Czernowitz, Czernowitz, Austria
1882			‖Price, A. F., 524, Sacramento-street, San Francisco, Cal., U S.A.
1899			Price, R. C., Prof., Virginia Polytechnic Institute, Blacksburg, Virginia, U.S.A.
1901	Trans.		Price, T. Slater, D.Sc., Ph.D., Chemical Department, Municipal Technical College, Suffolk-street, Birmingham
1903			Prichard, George Montague, Ramtek, Nagpur, C.P., India
1889			‖Priestley, Charles W., B.Sc., Cotesleigh, Torquay
1870			Pritchard, William, Prof., President Royal Veterinary College, N.W., and 5, Regent's Park-road, Gloucester-gate, N.W.
1871	Trans.		‖Procter, Henry R., Prof., F.I.C., The University, Leeds, and Rowangarth, Ben Rhydding, viâ Leeds
1889			Proctor, Charles, 99, Underhill-road, East Dulwich, S.E.
1896	Proc.		Proude, James, 30, Cromwell-terrace, Halifax
1897			Pullar, H. S., Pullar's Dye Works, Perth, N.B.
1882			‖Pullar, Rufus D., Brahan, Perth
1902			Puntan, Herbert Harding Cruikshank, Borough Analyst, London-chambers, Durban, Natal
1903			Purcell, Charles Stanley, 37, Acomb-street, Greenheys, Manchester
1875	Trans.	C. 1888-92 V.P. 1899-1902	Purdie, Thomas, Prof., Ph.D., LL.D., B.Sc., F.R.S., The University, St. Andrews, N.B.
1901			Purvis, J. E., M.A., University Chemical Laboratory, Cambridge
1886			Pyke, L. S. M., M.I.C.E., 10, Westbourne-terrace, Hyde Park, W.
1868			Quibell, Oliver.
1894			Quinn, Gerald G., 2, Willesden-avenue, Victoria-park, Manchester
1901			Radcliffe, L. G., 6, Alma-terrace, Old Trafford, Manchester

Date of Election.			
1902			Ralph, Stephen Jamieson, 56, Brudenell-mount, Hyde Park, Leeds
1902			Ralphs, Edwin, Queen's College, Hong Kong
1897			Ralston, William, B.Sc., F.I.C., 3, Windsor-terrace, Linthouse, Govan, Glasgow
1892	Trans.		‖Ramage, Hugh, B.A., A.R.C.S., The Technical Institute, Norwich
1873	Trans.	C. 1886-9 V.P.92-5, 1897-1900 F.S. 1902-	†‖Ramsay, Sir William, K.C.B., Ph.D., LL.D., Sc.D., F.R.S., University College, W.C., and 19, Chester-terrace, Regent's Park, N.W.
1901			Ramsden, W. C., 15, Windsor-avenue, Fairview, Clontarf, Dublin
1902			Ramshaw, Walter, 16, High-street, Shaftesbury
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1880			‖Rawson, Christopher, F.I.C., 2, Melbourne-place, Bradford
1884	Trans.		‖Rawson, Sidney George, D.Sc., Technical College, Huddersfield
1898			Ray, J. Armstedt, jun , B.A., 15, Nassau-street, Dublin
1902	Trans.		Rây, Prafulla Chandra, Prof., Presidency College, Calcutta
1889	Trans.		‖Read, Arthur A., 3, Fitzalan-place, Cardiff
1895			Read, E. J., B.A., F.I.C., St. Ives, The Avenue, Gravesend, Kent
1899	Trans.		Read, H. M., North Lodge, 173, Castlenau, Barnes, S.W.
1900			Readman, James Fraser, 50, Jane-street, Glasgow
1890			Redding, Richard James, 29, Isla-road, Plumstead, Kent
1904			Redfern, Herbert Stanley, B.Sc. (Vict.), U.M.F.C. College, Ningpo, China
1892			Redman, Henry Ramsden, 150, Canterbury-road, New Brompton
1866		C. 1891-2	Redwood, Boverton, D.Sc. (Ohio), F.R.S.E., F.I.C., 4, Bishopsgate-street-within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, T. Horne, F.I.C., 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D., 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrsthof, 8, South Park-hill-road, South Croydon
1880			‖Regester, William, Lawn Lodge, Isleworth, Middlesex
1897			Reid, A. F., Bonshaw, Stewarton, Ayrshire
1893			Reid, Thomas Anderson, c/o Messrs. Johnsen, Jörgensen, and Wettre, 38, Victoria-buildings, Manchester
1881			‖Reid, Walter Francis, F.I.C., Fieldside, Addlestone, Surrey
1886			Remington, J. Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1897			Remington, J. Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1879	Trans.		Rennie, Edward H., Prof., D.Sc., Univ. of Adelaide, S. Australia
1898	Proc.		Renwick, F. F., "Glengall," Woodford Green, Essex

† Longstaff Medallist, 1897.

Date of Election.			
1902	Trans.		Revis, Cecil, 77, King-street, Hammersmith, W.
1873	Trans.	V.P. 1881-4, 89-92, 97-1900. P. 1901-1903	Reynolds, James Emerson, Prof., Sc.D., M.D., F.R.S., 29, Campden Hill Court, Kensington, W.
1898	Trans.		Reynolds, W. Colebrook, B.Sc., Roseleigh, Essex-road, Dartford, Kent
1903			Rhind, Thomas, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 69, Gloucester-road, Regent's Park, N.W.
1898	Trans.		Rich, E. M., 5, Woodhill-terrace, Tivoli, Cork, Ireland
1903			Rich, Stiles William George, c/o Messrs. Thomason Chater, Ltd., Stanley-street, South Brisbane, Queensland
1889			Richards, Duncan T., 57, Osborne-avenue, Westoe-lane, South Shields
1889			‖Richards, Edgar, c/o G. K. Richards, Esq., 16, Lafayette-square, Washington, D.C., U.S.A.
1889			‖Richards, Percy A. E., F.I.C., 51, Rowan-road, Brook Green, W.
1886			Richards, William, B.Sc., The Clock House, Tooting, S.W.
1898			Richards, William, Flora Cottage, Eastbourne, Darlington
1885	Trans.		‖Richardson, Arthur, The Central Hindu College, Benares, N.W.P., India
1888	Trans.		‖Richardson, Clifford, Director, New York Testing Laboratory, Long Island City, New York, U.S.A.
1883			Richardson, F. W., Broad Oak, Oak-avenue, Bradford
1903			Richardson, Harold Ernest, B.A., B.Sc. (Lond.), 63, Lansdowne-road, Seven Kings, Ilford, Essex
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert N. B., 10, Friar-lane, Leicester
1866			Richardson, Joseph, Pansei View, Arran-avenue, Marsland-road, Sale, Manchester
1892			Richardson, Reginald E. S., 10, Friar-lane, Leicester
1887	Trans.		Richmond, H. Droop, F.I.C., 8, Woodfield-road, Ealing, W.
1845			‖Rickard, W. T., 136, Maygrove-road, West Hampstead, N.W.
1903			Ricketts, Guy Dunstan, M.A. (Cantab.), Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1894			Riddick, D. G., Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc., F.I.C., 28, Victoria-street, Westminster, S.W.
1895			Ridge, W. T. B., 2, Ashwood-terrace, Longton, Staffs.
1882	Trans.		Ridsdale, C. H., Ferndale, Linthorpe, Middlesbrough
1888			Rigby, John S., 26, Bagot-street, Wavertree, Liverpool
1898			Rigg, Gilbert, 115, Manchester-road, Hapton, near Burnley, Lancs.
1851	Trans.	C. 1878-80	Riley, Edward, F.I.C., 14A, Finsbury-square, E.C.

Date of Election.		
1904		Riley, Louis John Eczekiel, 13, Kensington-gardens-square, W.
1900		Riley, W. A., Brunswick Lodge, Newmarket-road, Norwich
1893		Rintoul, William, Royal Gunpowder Factory, Waltham Abbey
1902		Roast, Harold James, Y.M.C.A., Montreal, Quebec, Canada
1893		Robbins, James H., B.Sc., 4, Selborne-road, Ilford
1897		Roberts, E. H., 81, Cicada-road, Wandsworth, S.W.
1883		‖Roberts, Frederick G. Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899		Roberts, James, jun., 43, Great Western-road, Glasgow
1902		Roberts, Jonathan Hugh, Jamaica College, Kingston, Jamaica
1876		Roberts, Martin Fenn, General Post Office, E.C., and Mabshill, Epsom.
1889		Roberts, R. Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894		Roberts, Thomas John, Cowley Villa, 33, Serpentine-road, Liscard, Birkenhead
1880		Roberts, W. Brittain, Wilderspool House, Warrington, Lancs.
1894		Robertson, A. B., Struan, Giffnock, Glasgow
1904		Robertson, Franklin Ernest, Gloster House, Harders-road, Peckham, S.E.
1903		Robertson, Frederick, The Hewan, Bearsden, Glasgow
1904	Trans.	Robertson, Philip Wilfred, 20, Talavera-terrace, Wellington, New Zealand
1901	Trans.	Robertson, William, 9, Thirsk-road, Lavender Hill, Battersea, S.W.
1889		Robins, Harry H., c/o Messrs. Southwell and Co., Dockhead, S.E.
1903		Robinson, Archibald Louis, B.A. (Dub.), 40, Trinity College, Dublin
1896		Robinson, Henry Fishwick, M.Sc., 2, Richmond-street, Droylsden-road, Newton Heath, Manchester
1882	Trans.	‖Robinson, Henry Haliburton, M.A., F.I.C., 75, Finborough-road, West Brompton, S.W.
1895		Robinson, Herbert Lewin, c/o Messrs. Vickers, Sons & Maxim, Ltd., Erith Works, Erith
1901		Robinson, William Hammond, Ribblesdale, Cardiff-road, Llandaff, South Wales
1904		Rodger, Robert, 54, Rostrevor-road, S.W.
1898		Rofe, H. J., M.A., 8, Victoria-street, Westminster, S.W.
1883		Rogers, Arthur W., Tadcaster Tower Brewery Co., Tadcaster
1884		Rogers, Francis M., 21, Burma-road, Stoke Newington, N.
1904		Rogers, William David, 36, Grange-road, Smethwick
1894		Rolfe, John F., Rock Mount, Whalley-road, Accrington
1903		Roose, Fitzroy Owen Jonathan, A.M.I.C.E., Marlow, Oxford-road, Bournemouth

Date of Election.			
1886			Roose, Robson, M.D., 49, Hill-street, Berkeley-square, W.
1855	Trans.	C. 1860-4 1871-3. V.P. 73-5 1877-80. P. 80-2	Roscoe, Sir Henry Enfield, LL.D., D.C.L., M.D., D.Sc., Ph.D., F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8	‖Rose, T. K., D.Sc., 9, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D., 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, 1, Glengall-road, Old Kent-road, S.E.
1903			Ross, George Archibald Park, M.B., Ch.B. (Edin.), D.P.H., 20, Westhall-gardens, Edinburgh
1881			Ross, Henry, Rev., LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, Raymond St. George, F.I.C., Public Analyst, Burnley
1902			Ross, William Charles, c/o Miss Methuen, 6, Stirling-road, Trinity, Edinburgh
1891	Proc.		Rossiter, Edmund Charles, Bloxidge House, Langley, Birmingham
1896			Rostron, Harold, B.Sc., 202, Tonge Moor-road, Bolton
1892			Rothwell, C. F. Seymour, Beech Croft, Mobberley, Knutsford
1899			Roundell, C. Foulis, Lieut., Guards' Club, Pall Mall, S.W.
1900			Row, M. C. Nanjunda, B.A., M.B., Mylapore, Madras, India
1894			Rowntree, Walter Smithson, B.Sc., F.L.S., Leighton-park, Reading
1900			Roy, M. Goolab, Chintadirpetah, Madras, India
1901			Royle, C. L., Nellikuppam, S. Arcot, India
1862			‖Royle, Thomas, F.I.C., 329, Upton-lane, Forest Gate, E.
1872	Trans.		Ruffle, John, F.I.C., Musley, Ware, Herts.
1895			Rugginz, W. A., "Strathmore," 14, Empress-avenue, Cranford-park, Ilford
1889	Trans.	C. 1903-	Ruhemann, Siegfried, M.A., Ph.D., Gonville and Caius College, Cambridge
1883			Rumble, Charles, 9, Sangora-road, New Wandsworth, S.W.
1890			‖Russell, Edward, B.Sc., F.I.C., 55, St. Ronan's-road, Southsea
1899	Trans.		Russell, E. J., D.Sc., S.E. Agricultural College, Wye, Kent
1901			Russell, J. B., B.Sc., 46, Spencer-avenue, Wood Green, N.
1899			Russell, William, Thetford, Norfolk
1851	Trans.	C. 1863-7, 1870-2. V.P. 1872-3 S. 1873-5 T. 1875-89 P. 1889-91	‖Russell, William James, Ph.D., F.R.S., 34, Upper Hamilton-terrace, St. John's Wood, N.W.
1896			Rutter, T. F., B.Sc., 120, Upper Tulse Hill, S.W.
1894			Ryce, George, B.A., Irish Agricultural Offices of the Potash Syndicate, 50, Essex-street, Dublin
1901	Trans.		Ryffel, J. Henry, M.A., B.Sc., 10, Grasmere-road, Muswell Hill, N.

Date of Election.		
1888		Sach, A. J., Technical College, Goulburn, N.S.W.
1868		Sadler, S. A., Col., M.P., Cleveland Chemical Works, Middlesbrough
1896		Sage, C. E., 2, Charterhouse-street, E.C.
1898		St. John, Harry, Thornfield, Sunderland
1879	Trans.	‖Sakurai, Joji, Prof. Science College, Imperial University, Tokio, Japan
1880		Salamon, Alfred Gordon, A.R.S.M., F.I.C., 2, Belgrave-place, Belgrave-square, S.W.
1876		‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and Berkeley Chambers, 13, Bruton-street, Hyde Park, W.
1896		Salt, A. P., Rosecroft, St. James-road, Sutton, Surrey
1863		‖Salt, Henry, M.D., C.M., F.R.G.S., Inglewood, Great Malvern
1871		‖Salter, Mortyn John, 65, Park-road, Crouch End, N.
1859		‖Salter, Thomas W., 193, Priory-road, West-hill, Hastings
1903		Sampson, John William, Cleveland Pharmacy, Bath
1903		Samuel, Thomas, B.A. (Lond.), School of Science & Art, Liscard, Cheshire
1882		Samuel, W. Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.
1898	Proc.	Sand, H. J. S., Ph.D., University College, Nottingham
1870		‖Sandberg, C. P., Palace-chambers, 9, Bridge-street, Westminster, S.W.
1900		Sanders, J. McConnell, c/o Direccion General de Aduanas, Mexico
1904		Sanders, Percy Richard, West Cliffe, Seaford, Sussex
1888		Sanderson, John, c/o Messrs. B. S. Cohen, Ltd., 15, Clerkenwell-close, E.C.
1901		Sandford, Allan, 6, Market-street, Dalton-in-Furness, Lancs.
1900		Sandford, J. Wallace, c/o Messrs. A. W. Sandford and Co., Grenfell-street, Adelaide, South Australia
1901		Sandford, Thomas, 8, Market-street, Dalton-in-Furness
1882		Sanford, P. Gerald, Laboratory, 20, Cullum-street, E.C.
1890		Saniter, Ernest Henry, Strafford Villa, Moorgate, Rotherham
1891		Sanyal, Abhayacharan, M.A., Professor of Physical Science, Queen's College, Benares, N.W.P., India
1892		Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900		Sargeant, F. Pilkington, Springfield-place, Leeds
1886		Saunders, William, Prof., Experimental Farm, Ottawa, Ontario Canada
1896		Saville, A. E., Gas Works, Gas-street, Bolton
1903		Sawdon, Ernest William, B.Sc. (Vict.), 2, Esk-terrace, Whitby
1898		Sayer, H. C., 51, Highfield-road, Dartford
1890		Sayers, William Charles, 63, High-street, Lewisham, S.E.

Date of Election.			
1885			Scammell, Luther R., 42–4, King William-street, Adelaide, South Australia
1877			Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897			Scargill, L. W. K., B.A., 1, Devonshire-road, Birkenhead
1893	Trans.		Schidrowitz, Philip, Ph.D., 57, Chancery-lane, W.C.
1888			‖Schieffelin, William Jay, Ph.D., 840, Southern-boulevard, New York, U.S.A.
1892			‖Schofield, James Alexander, A.R.S.M., F.I.C., The University, Sydney, N.S.W.
1903			Scholefield, Alfred Henry, B.A., B.Sc. (Lond.), Church-road, Penn Fields, Wolverhampton
1902			Scholes, William, 151, Ainsworth-road, Radcliffe, Lancs.
1899	Trans.		Schryver, S. B., D.Sc., Ph.D., 27, Arundel-gardens, Notting Hill, W.
1899			Schweich, E. M., 20, Hyde-park-square, W.
1896			Scotland, P. B., c/o The Arizona Copper Co., Ltd., Metcalf Mines, Clifton, Arizona, U.S.A.
1879	Trans.	C. 1897-9 S. 1899-1904 T. 1904-	‖Scott, Alexander, M.A., D.Sc., F.R.S., F.I.C., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, G. C., Bengal Iron and Steel Co., Ltd., Burrakur, Bengal, India
1883	Proc.		Scudder, Frank, 44, Mosley-street, Manchester
1896			Seabrooke, Herbert Cecil, F.I.C., "Black Ash," Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup, Kent
1890			Seaton, Edward Cox, M.D., 93, St. George's-square, S.W.
1899			Seligman, Richard, Ph.D. (Heidelberg), A.C.G.I., 17, Kensington-palace-gardens, W.
1892	Trans.		Sell, William James, M.A., F.R.S., University Chemical Laboratory, Pembroke-street, Cambridge
1875			Sellon, J. Scudamore, 78, Hatton-garden, E.C.
1904	Trans.		Sen, Jatindranâth, M.A. (Calcutta), 71, Cathedral Mission-lane, Calcutta, India
1875	Trans.		‖Senier, Alfred, Prof., M.D., Ph.D., Queen's College, and Gurthard, Galway
1887			Senier, Harold, F.I.C., Braybrooke Lodge, Harrow,
1899			Senior, George, B.A., 109, Brynland-avenue, Bishopston, Bristol
1904			Senter, George, Ph.D. (Leipzig), B.Sc. (Lond.), 37, Ronalds-road, Highbury, N.
1893			Sessions, Wilfred, B.Sc., Dalton House, Kendal

Date of Election.			
1896			Severn, W. D., Colonial Bacteriological Institute, Grahamstown, Cape Colony, South Africa
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co., Wandle Colour Works, Wandsworth, S.W.
1874			‖Sexton, A. Humboldt, F.I.C., F.R.S.E., Prof., Metallurgical Department, Andersonian-buildings, 204, George-street, Glasgow
1895			Seyler, C. A., B.Sc., F.I.C., The Technical Institute, Nelson-terrace, Swansea
1904			Shacklady, Thomas George, Addiscombe-villas, Cliffe-at-Hoo, Rochester, Kent
1880			Shadwell, J. E. L., Charlecote, Lansdown, Bath
1893			‖Shapley, Frederick, c/o Messrs. C. E. Johnson & Co., 509, South Tenth-street, Philadelphia, U.S.A.
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, Shirley Manor, Wyke, near Bradford
1895			Sharrott, T. C., B.A. (Dub.), Bovey Tracey School, Devon
1895	Trans.		Shaw, G. E., B.Sc., F.I.C., 45, Colworth-road, Leytonstone, N.E.
1887			Sheard, John T., Birley Mount-villas, Wadsley Bridge, near Sheffield
1899			Shelbourn, E. T., F.I.C., 40, Craven-street, Strand, W.C.
1899			Shelton, A. J., Morriston-place, Clydach, R.S.O., Glamorgan
1904	Proc.		Shelton, Henry Stanley, 4, Larden-road, Acton Vale, W.
1876	Trans.	C. 1893-7	‖Shenstone, W. A., F.R.S., Clifton College, Bristol
1897			Shenton, James Porter, 37, Torbay-road, Chorlton-cum-Hardy, near Manchester
1899	Trans.		Shepheard, W. F. J., 12, Bridge-street-row, Chester
1874			‖Shepherd, H. H. B., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899			Shepherd, J. W., B.Sc., 48, Ovington-street, S.W.
1901			Sheppard, S. E., Ravensmere, Bromley-road, Catford, S.E.
1901			Shepperson, William, Abbey-court, Abbey-road, N.W.
1898			Sheridan, M. J., Collector of Customs, Middlesbrough
1901			Sherratt, C. E. S., 3, Francis-street, Florence, Longton, Staffs.
1901			Sherwood, E. C., Rev., St. Peter's College, Westminster, S.W.
1891	Trans.		‖Shields, John, Ph.D., D.Sc., 4, Stanley-gardens, Willesden Green, N.W.
1896			Shimomura, Kotaro, Prof., Osaka Seimi Works Co., Kawagishicho, Nishiku, Osaka, Japan
1894			Shorthouse, H. S., 47, Pershore-road, Birmingham
1904			Shrubsole, Alfred, 91, Holyhead-road, Coventry
1886			Shutt, Frank T., M.A., Experimental Farm, Ottawa, Canada
1890			Shuttlewood, W. Brewin, 78, Whitehall-park, Hornsey-lane, Highgate, N.
1894			Shuttleworth, E. B., Prof., 220, Sherborne-street, Toronto, Canada

Date of Election.		
1904		Siau, Raymond Louis, 15, Merridale-lane, Wolverhampton
1903		Sibley, Samuel Edward, 3, Rutland-road, Ilford, Essex
1859		Sibson, Alfred, 23, St. Mary Axe, E.C.
1889		Sibson, Alfred Edward, 19, Carlingford-road, Hampstead, N.W
1901		Sichel, G. T. S., F.R.C.S. (Eng.), L.R.C.P. (Lond.), The Lawn Portsmouth-road, Guildford
1903		Siddle, George, Middleton-one-row, R.S.O., Co. Durham
1902		‖Sidgwick, Nevil Vincent, M.A., D.Sc., Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D., 51, Shooter's Hill-road, Blackheath, S.E
1886		Silvester, Harry, 78, Holy Head-road, Handsworth, Birmingham
1899	Trans.	Simmonds, Charles, B.Sc., "Northcroft," Deronda-road, Herne Hill, S.E.
1889		Simmonds, Henry, Engineer's Office, Gas Works, and Elton View House, Bury, Lancs.
1887		‖Simmons, L. Owen, 360, Coldharbour-lane, Brixton, S.W.
1895		Simons, A. J., c/o M. Simons, Esq., 31, Little Britain, E.C.
1896		Simpson, A. M., Elmcroft, 26, Nelgarde-road, Catford, S.E.
1903		Simpson, Duncan Ivan Rennard, P.O. Box 4225, Johannesburg Transvaal, South Africa
1897		Simpson, E. S., B.E., Geological Survey Laboratory, Museum street, Perth, West Australia
1886		‖Simpson, William Selby, 17, Lake Side-road, Palmer's Green, N
1903	Proc.	Sindall, Robert Walter, 201, Wellmeadow-road, Catford, S.E.
1889		Singer, Ignatius, c/o Messrs. Whitaker Bros. and Co., Newlay near Leeds
1902		Sinnatt, Frank S., Glenside, Church-lane, Moston, Manchester
1896		‖Sircar, Amrita Lal, 51, Sankaritola, Calcutta, India
1902		Skertchly, William Pearson, F.I.C., 11, Billiter-square, E.C.
1888	Trans.	Skinner, Sidney, M.A., South Western Polytechnic, Manresa-road Chelsea, S.W.
1899	Trans.	Skirrow, F. W., M.Sc. (Vict.), Ph.D. (Leipzig), c/o The Manchester Oxide Co., Canal-street, Miles Platting, Manchester
1892		Skurray, Thomas, United Breweries, Abingdon, Berks.
1879		Slater, Charles, M.A., M.B., M.R.C.S., 81, St. Ermin's-mansions Westminster, S.W.
1880	Trans.	‖Slater, Harold H., St. Lawrence, Borstal-road, Rochester, Kent
1903	Trans.	Slator, Arthur, Ph.D. (Leipzig), M.Sc. (Birm.), B.Sc. (Lond.) University College, Nottingham
1878		‖Slatter, George William, A.R.C.S., F.I.C., Carlton-terrace, Nab Wood, Shipley, Yorks.
1895		Slocum, F. L., 401, South Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		‖Smetham, Alfred, F.I.C., Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool

Date of Election.		
1898	Trans.	Smiles, Samuel, D.Sc., University College, Gower-street, W.C.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	‖Smith, Alexander, Ph.D., B.Sc., University of Chicago, Chicago, Ill., U.S.A.
1901		Smith, Andrew Biggam, c/o M. Armstrong, Esq., P.O. Box 90, Queenstown, Cape Colony, South Africa
1888		Smith, Angus, 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, B. Jordan, 58, King's-road, Reading, and 9, Broxtowe-drive, Mansfield, Notts.
1903		Smith, Charles Joseph, Sunnydale, Walton New-road, Stockton Heath, near Warrington
1904	Trans.	Smith, Clarence, D.Sc. (Lond.), Denmark Lodge, St. James', Hatcham, S.E.
1894	Trans.	Smith, Claude, Barngarth, Cartmel, Carnforth
1884	Trans.	‖Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1900		Smith, E. Shrapnell, Cecil Chambers East, Strand, W.C.
1904		Smith, Frank Gurney, 7, Luxemburg-gardens, Brook Green, W.
1892		‖Smith, Fred., P.O. Box 1324, Johannesburg, Transvaal, S. Africa
1874		Smith, George, Nobel's Explosives Co., Polmont Station, N.B.
1896		Smith, G. E. Scott, 67, Surrey-street, Sheffield
1892		‖Smith, George P. Darnell-, The Merchant Venturers' Technical College, Bristol
1901		Smith, H. Ewing, 22, City-road, E.C.
1896	Trans.	Smith, H. G., The Technological Museum, Sydney, N.S.W.
1904		Smith, Henry Heron, 76, Plumstead-common-road, Plumstead, Kent
1900		‖Smith, H. Procter, Shotton-lane, Shotton, Flints.
1878		Smith, H. R., 1, Aubert-park, Highbury, N.
1890		Smith, Harry Wood, B.Sc., c/o Messrs. John Batt and Co., Ltd., 39, Old Broad-street, E.C.
1901		Smith, James, 30, Milner-road, Aigburth, Liverpool
1903		Smith, James Cruickshank, B.Sc., 19, Aldridge-road-villas, Bayswater, W.
1879		Smith, J. W., 7, Brookfield-street, Roslindale, Boston, Mass., U.S.A.
1903		Smith, Leonard, Hillside, Park-hill-road, Croydon
1901	Trans.	Smith, Norman, B.Sc., Owens College, Manchester
1902		Smith, Robert Ely Blake, B.Sc., A.I.C., 31, St. John's-road, Putney, S.W.
1897		Smith, Robert Francis Wood, 89, Bartholomew-close, E.C.
1891		Smith, R. Greig, D.Sc., Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1888		Smith, Samuel, Hillsboro', Goddard-avenue, Old Swindon

Date of Election.			
1904			Smith, Samuel John, 41, Grafton-street, Dublin
1898			Smith, T. D., M.A., Moor Platt, Caton, near Lancaster
1876			‖Smith, W. A., M.A., M.B. (Oxon.), M.R.C.S. (Eng.), Newport, Essex
1866	Trans.		Smith, Watson, 34, Upper-park-road, Haverstock Hill, N.W.
1904			Smith, William Veysey, B.A. (Oxon.), 81, Surrey Street, Norwich
1883	Trans.	C. 1896-1900	‖Smithells, Arthur, Prof., B.Sc., F.R.S., The University, Leeds
1873			‖Smyth, John, M.A., Milltown, Bantridge, Ireland
1902			Smythe, John Seabury, B.Sc. (Vict.), Ph.D. (Würzburg), "Rantallard," Lance-lane, Wavertree, Liverpool
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc., Ph.D., Balholm, Lathom-road, Southport
1899	Trans.		Soddy, Frederick, M.A., Chemical Department, The University, Glasgow
1896	Trans.		Sodeau, W. H., B.Sc., 114, Park-road, Newcastle-on-Tyne
1887			Sohn, Charles E., F.I.C., 2, Harpur-street, Bedford-row, W.C.
1891			Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1874	Trans.		Sonstadt, Edward, Church Field, Cheshunt, Herts.
1893			Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875			Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897	Proc.		Southerden, Frank, B.Sc., Royal Albert Memorial College, Exeter
1897			Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902			Southworth, William, Agricultural and Horticultural College, Uckfield, Sussex
1883			Soward, Alfred W., 28, Therapia-road, Honor Oak, S.E.
1892			Spackman, Charles, Rosehaugh, Clitheroe, Lancs.
1901			Spence, J. D., 2, Hawk Hill-place, Perth-road, Dundee
1883			‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1886			Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887			Spencer, W. Shelley, Lyndene, Darley-grove, Farnworth, near Bolton
1894			Spenzer, John George, Prof., M.D., Ph.D., Ohio Wesleyan University, 261, Amesbury-avenue, Cleveland, Ohio, U.S.A.
1859	Trans.		‖Spiller, John, F.I.C., 2, St. Mary's-road, Canonbury, N.
1863			‖Spiller, William, F.I.C., Atlas Dye Works, Hackney Wick, E.
1885			‖Spottiswoode, W. Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1864	Trans	C. 1872-6	Sprengel, Hermann Johann Philipp, Ph.D. (Heidelb.), F.R.S., Royal Prussian Professor (titular), Savile Club, 107, Piccadilly, W.
1882			‖Squire, P. Wyatt, 413, Oxford-street, W.

Date of Election.		
1858	Trans.	Squire, W. Stevens, Ph.D., Clarendon House, St. John's Wood-park, N.W.
1892		Squires, Alfred James, "Greenbank," Coroner's-lane, Farnworth, Widnes, Lancs.
1877		Stacey, Henry George, 300, High Holborn, W.C.
1899		Stainer, John Ward, 103, Cheriton-road, Folkestone
1897		Stainer, William James, B.A., Torquay-villa, Southdown-avenue, Brighton
1879	Trans.	‖Stallard, George, M.A., Horton-crescent, Rugby
1904		Stanger, Reginald Harry Hursthouse, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W.
1902		Stanger, William C. S., Ambleside, Corder-road, Ipswich
1887		‖Stansell, Lionell W., 7, Albion-place, Maidstone, Kent
1895		‖Stansfield, Alfred, D.Sc., McGill University, Montreal, Canada
1903		Stansfield, Edgar, B.Sc. (Vict.), The Technical College, Sunderland
1899		Stansfield, Samuel, B.Sc., Hollins-crescent, Hebden Bridge, Manchester
1900	Trans.	Stapleton, H. E., Prof., B.A., Presidency College, Calcutta, India
1870		Starey, Arthur J., 39, Woodland-gardens, Highgate, N.
1870	Trans.	‖Stark, J. Fleming, Rosedale, Bromborough, Cheshire
1902		Stead, Francis Bernard, Clifton College, Bristol
1896		Stead, J. C., 42, Grove-green-road, Leytonstone, N.E.
1882	Trans.	Stead, J. E., F.R.S., 11, Queen's-terrace, Middlesbrough
1897		Steel, F. W., c/o Messrs. Cuning Smith and Co., Yarraville, Melbourne, Victoria
1885		Steel, Robert Elliot, County School, Northampton
1890		Steel, Thomas, c/o Colonial Sugar Refining Co., O'Connell-street, Sydney, N.S.W.
1900	Trans.	Steele, Bertram D., B.Sc., Heriot-Watt College, Edinburgh
1898		Steinhart, O. J., Ph.D., Blackfriars Testing Works, 91, Blackfriars-road, S.E.
1901		Stell, Samuel Fenton, 25, Henry-street, Keighley
1892	Trans.	‖Stenhouse, James, View-park-gardens, Bonnyrigg, Midlothian, N.B.
1884		Stenhouse, Thomas, Townhead, Rochdale
1895	Trans.	Stephens, F. R., c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880		‖Stephens, Henry Charles, M.P., Avenue House, Finchley, N.
1897		Stephens, M. E., 57, Aldersgate-street, E.C.
1895		Stephenson, Herbert F., Fairhaven, Lucien-road, Tooting Common, S.W.
1902		Stephenson, Robert, jun., B.A., Burwell, Cambridge
1891	Trans.	Stephenson, Thomas, 137, George-street, Edinburgh

Date of Election.			
1888	Trans.		Stern, Arthur Landauer, D.Sc., F.I.C., Southbank, Stapenhill, Burton-on-Trent
1896			Steuart, Douglas Stuart Spens, B.Sc., The Royal Societies' Club, St. James's-street, S.W.
1903	Trans.		Steven, Alec Bowring, B.Sc. (Lond.), The University, Leeds
1897	Trans.		Stevens, Henry Potter, M.A., Ph.D., F.I.C., 15, Borough, London Bridge, S.E.
1903			Stevens, Montague White, A.R.C.S., A.I.C., H.M. Patent Office, 25, Southampton-buildings, W.C.
1899			Stevenson, Arnold, B.A., 4, Porchester-gardens, W.
1903	Trans.		Stevenson, Henry Edward, 5, Turners-road, Bow, E.
1904			Stevenson, Henry Ernest, "Avondale," Ditton Hill, Surrey
1864		C. 1872-5, 86-8, 94-7 V.P. 1900-03.	Stevenson, Sir Thomas, M.D. (Lond.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1904			Stewart, Alfred Walter, 18, Annfield-terrace, Partickhill, Glasgow
1902			Stewart, Hector, General Manager, Knight's Petersburg Gold Mines, Ltd., Petersburg, Transvaal, South Africa
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, W. F. K., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcs.
1887			Stocks, Herbert B., Lynwood, Neston, Cheshire
1894	Trans.		Stoddart, Frederick Wallis, Grafton Lodge, Sneyd Park, Bristol
1879	Proc.		‖Stokes, Alfred Walter, Vestry Hall, Paddington, W.
1873			‖Stone, Edward Daniel, Ackersley, Cheadle Hulme, near Stockport, Cheshire
1895			Stone, George, Ulverstone, Tasmania
1875			‖Stone, J. Harris, M.A., F.L.S., Barrister-at-Law, 4, Temple, E.C.
1879			‖Stone, William, M.A. (Cantab.), F.L.S., Oxford and Cambridge, Garrick and Union Clubs, and I, 5 and 6, The Albany, Piccadilly, W.
1891			‖Storey, James Ashburner, B.Sc., Igalkanda Estate, Elpitiya, Ceylon; and Underfell, Lancaster
1900			Storr, B. V., B.Sc., 61, Balfour-road, Ilford, Essex
1887			‖Strangman, J. Pim, 38, Rue Desbordes-Valmore, Paris-Passy
1904	Trans.		Streatfeild, Frederick Henry, 9, Crescent-road, South Tottenham, N.
1900			Strong, A. H., 63, Herne-hill-road, Camberwell, S.E.
1904	Proc.		‖Struthers, Robert de Jersey Fleming-, B.A., Exeter College, Oxford

Date of Election.		
1885	Trans.	‖Stuart, Charles M., M.A., St. Dunstan's College, Catford, S.E.
1897	Trans.	Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1893		Styles, R. Curling, A.R.S.M., F.I.C., Knockhall, Greenhithe, Kent
1890	Trans.	‖Sudborough, John Joseph, Prof., D.Sc., Ph.D., F.I.C., University College of Wales, Aberystwyth
1878	Trans.	‖Suguira, Shigetake, c/o Tokio Chemical Society, 50, Kasugacho, Koishikawa, Tokio, Japan
1897		Sumner, Leonard, B.Sc., Butt Hill, Prestwich, near Manchester
1887		‖Sutherland, D. A., F.I.C., 13, Victoria-street, Westminster, S.W.
1884		Sutton, C. W., Paget House, Ipswich
1860		Sutton, Francis, F.I.C., Laboratory, Bank Plain, Norwich
1886		‖Sutton, Francis Napier, F.I.C., 6, Grosvenor-gardens, Willesden Green, N.W.
1902		Swain, James, 17, Winsham-street, West-side, Clapham Common, S.W.
1875		Swan, Joseph Wilson, M.A., D.Sc., F.R.S., 58, Holland-park, W.
1894		‖Swinburne, James, 82, Victoria-street, S.W.
1891		Sykes, M. Carrington, M.D. (Durham), F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Lond.), Sykeshurst, Barnsley, Yorks.
1880		Symons, Brenton, Burwood, Warminster-road, South Norwood, S.E.
1874	Trans.	‖Symons, William H., M.D. (Brussels), D.P.H. (Oxon.), M.R.C.S. (Eng.), F.I.C., Health Office, Guildhall, Bath
1899	Trans.	Szarvasy, E. C., Ph.D., Muegyetem VIII, Budapest, Hungary
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokio, Japan
1887	Trans.	‖Takamine, Jokichi, 613, West 142nd-street, New York, U.S.A.
1901		Tankard, A. R., 67, Surrey-street, Sheffield
1894		Tanner, Alfred E., Westminster Hospital, S.W.
1901		Tatam, G. W. G., 1, Hagley-grove, Hagley-road, Birmingham
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D., Windsor Buildings, George-street, Liverpool
1884		‖Tate, Walter, The Woodlands, Twerton-on-Avon, Bath
1890		Tate, William, Prof., 80, Chambercombe-road, Ilfracombe, Devon
1867		Tatlock, Robert Rattray, F.I.C., Novara, Stirling
1897		Taverner, William, B.Sc., Ashland, Oregon, U.S.A.
1894		Taylor, Albert, 16, Wellington-grove, Stockport
1882		Taylor, Gotfred Midgley, 27, Great George-street, Westminster S.W.
1894		Taylor, Herbert J., 9, Portland-villas, Bath-street, Dewsbury
1880		‖Taylor, James, B.Sc., Blaen Crai, Dundas, New South Wales
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John G., 3, Outram-street, Stockton-on-Tees

Date of Election.			
1874	Trans.		Taylor, R. L., 37, Mayfield-road, Whalley Range, Manchester
1902			Taylor, Thomas, 12, Ancaster-drive, Great Western-road, Glasgow
1901			Taylor, William Henry, F.I.C., 4A, Durlston-road, Northwold-road, Upper Clapton, N.E.
1878			‖Tcherniac, Joseph, Ph.D., Thalstrasse 1, Freiburg, Briesgau, Germany
1879	Trans.		‖Teed, Frank L., D.Sc., F.I.C., 9, Mincing-lane, E.C.
1901			Templeman, W. H., 67, Park-street, Spring Bank, Hull
1894			‖Terry, Edwin, 374, Brixton-road, S.W.
1881			Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893			Thackrah, James R., M.A., Ph.D., Technical Schools, Tavistock-road, Plymouth
1895			Theodosius, A. F., B.A., University College, Oxford
1899			Thiersch, H. A., 8, Clifton-gardens, Maida Vale, W.
1901			Thomas, Albert Edward, B.Sc., F.I.C., Science and Technical Schools, Barrington-street, Tiverton, Devon
1871			‖Thomas, Charles, J.P., Stoke Bishop, near Bristol
1874			Thomas, Harry E., Rockleaze Point, Clifton, Bristol
1875	Trans.		‖Thomas, Joseph William, Overdale, 6, Kingswood-road, Shortlands, Kent
1877			‖Thompson, Beeby, 67, Victoria-road, Northampton
1904			Thompson, Charles Herbert, Hillcroft, Amblecote, Stourbridge
1886	Trans.		‖Thompson, Claude M., Prof., M.A., D.Sc., University College, and 38, Park-place, Cardiff
1894			Thompson, Edward Cumming, 40, Glenluce-road, Westcombe Park, S.E.
1893			Thompson, Frank Ernest, 51, Lichfield-road, Walsall
1893			Thompson, George Roos, The Laboratory, 69, Dock-street, Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1904			Thompson, Hubert, B.Sc. (Vict.), Agricultural College, Holmes Chapel, Cheshire
1886			Thompson, W. Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1903			Thomson, George Malcolm, Newington, Dunedin, New Zealand
1903			Thomson, George Sutherland, F.R.S.E., Dairy Commissioner, Department of Agriculture, Brisbane, Queensland
1872	Trans.	C. 1880-3, 1904- S. 1883-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., LL.D., F.R.S., F.I.C., King's College, W.C., and 9, Campden Hill-gardens, W.
1899			Thomson, Robert Tatlock, F.I.C., 156, Bath-street, Glasgow
1872			Thomson, William, F.I.C., Royal Institution Laboratory, Manchester
1895			Thomson, W. T., Oxford-villas, Waltham Abbey

Date of Election.			
1891			Thonger, C. G. Freer, The Grange, Hollesley, Suffolk
1882	Trans.		Thorne, Leonard Temple, Ph.D., F.I.C., 2, Denbigh-gardens, Richmond, Surrey
1891			Thorp, Walter, B.Sc., F.I.C., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph.D., Owens College, Manchester
1871	Trans.	C.1879-83 V.P. 84-7 T. 89-99 P. 1899-1901	†‖Thorpe, Thomas Edward, Prof., C.B., D.Sc. (Vict.), Sc.D. (Dubl.), Ph.D. (Heid.), LL.D. (Glas.), F.R.S., Government Laboratory, Clement's Inn-passage, W.C.
1899			Threlfall, Richard, Prof., M.A., F.R.S., 30, George-road Edgbaston, Birmingham
1880			Thwaite, B. H., 29, Great George-street, Westminster, S W.
1895			Tibbals, W. I., 187, Canton-avenue, Detroit, Mich., U.S.A.
1863	Trans.		Tichborne, C. R. C., Ph.D., 15, North Great George's-street, Dublin
1897	Trans.		Tickle, Thomas, B.Sc. (Lond.), F.I.C., 83, Queen-street, Exeter
1902			Tidy, Henry Letheby, B.A. (Oxon.), 15, Adam-street, Portman-square, W.
1903			Tighe, Arthur, 20, Marlborough-place, St. John's Wood, N.W.
1903			Tilburn, Charles, 31, Hardy-street, South Yarra, Melbourne, Australia
1865	Trans.	C.1878-81 V.P. 85-8 91-4, 96-9 T. 1899-03 P. 1903-	‖Tilden, William Augustus, Prof., D.Sc. (Lond.), Sc.D. (Dubl.), D.Sc. (Vict.), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W. ; and The Oaks, Northwood, Middlesex
1900			Tilley, James W., 95a, Southwark-street, S.E.
1902			Tindall, Arthur Lea Butler, M.A., Dagnall, Bakewell
1904	Trans.		Tingle, Alfred, B.Sc. (Lond.), Ph.D. (Penn.), Imperial Provincial College of Shantung, Chinanfu, Shantung, China
1889	Trans.		‖Tingle, J. Bishop, Prof., Ph.D., Johns Hopkins University, Baltimore, U.S.A.
1898			Tisdale, C. W. Walker, University College, Reading
1891			Tocher, James Fowler, F.I.C., 1, Chapel-street, Peterhead
1903			Tolson, Stanley, 5, Auckland-road, Doncaster
1900			Tomlins, G. E., Government Laboratory, Clement's Inn-passage Strand, W.C.
1884	Trans.		‖Tompson, Frederick William, The Bower, Limpsfield, Surrey
1877			‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1904			Tong, Walter, "Holmdene," Pole-lane, Failsworth, Manchester
1855	Trans.		‖Tookey, Charles, Museum of Practical Geology, Jermyn-street S.W., and The Portland Hotel, Great Portland-street, W.
1893			‖Towers, John William, Victoria-road, Widnes
1888			Townsend, Charles F., 1, Morgan-road, Bromley, Kent

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† Longstaff Medallist, 1881.

Date of Election.		
1903		Toyne, Francis Digby, c/o Messrs. Henry Ashwell & Co., New Basford, near Nottingham
1901		Tozer, H. A., B.A., 113, Stepney Green, E.
1887		‖Traphagen, Dr. Frank W., Prof., Colorado School ot Mines, Golden, Colorado, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris W., Prof., D.Sc., F.R.S., University College, Bristol
1895		Treharne, F. G., Wrangbrook, Llanishen, near Cardiff
1894		Trench, George, Toneta, Herne Bay, Kent
1888		‖Trewby, Herbert, 64, St. John-street, E.C.
1881		‖Trigger, Oliver, Chemical Dept., Royal Arsenal, Woolwich, S.E.
1902		Trimen, Stephen H., Survey Dept., Public Works Ministry, Cairo, Egypt
1897		Tripp, E. H., Ph.D., The Modern School, Bedford
1898	Trans.	Tucker, S. A., Ph.D., Columbia University, New York, U.S.A.
1889		Tucker, Willis G., M.D., Medical College, Albany, New York, U.S.A.
1896		Tuckett, J. E. S., M.A. (Cantab.), Marlborough College, Wilts.
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancs.
1902		Tunnicliffe, William Wright, B.Sc., Sunnyside, Newhall, Burton-on-Trent
1897	Trans.	Turnbull, Andrew, Ph.D., 3, Lord-street, Liverpool
1903		Turner, Arnold, 316, Entwisle-road, Rochdale
1886		Turner, Arthur, The Limes, Aylesbury
1896		Turner, B. Bernard, B.Sc., Ph.D. (Göttingen), Connecticut Agricultural College, Storrs, Conn., U.S.A.
1897		Turner, Basil W., Wood's-chambers, 5, Moore-street, Sydney, N.S.W.
1888	Trans.	Turner, Charles, 225A, Oxford-street, Manchester
1903		Turner, Duncan, c/o Kimberly Montana Mining Co., Jardine, Park Co., Montana, U.S.A.
1897		Turner, J. S., 20, Bury-street, Bloomsbury, W.C.
1902		Turner, Lyon Viccars, Crescent Lodge, St. John's, S.E.
1883	Trans.	‖Turner, Thomas, Prof., M.Sc., A.R.S.M., F.I.C., The University, Birmingham
1904		Turner, William Ernest Stephen, M.Sc. (Birm.), B.Sc. (Lond.), 52, Cheshire-road, Smethwick, Birmingham
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab.), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robert, F.R.G.S., Albion House, The Marina, Deal
1888	Trans.	Tutton, Alfred E. H., D.Sc., F.R.S., 17, Bardwell-road, Oxford
1879		Tweedie, G. R., Erleigh, Herschel Park, Slough
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1899	Trans.	Tyler, E. A., B.A., The Grammar School, Swansea

Date of Election.			
1876			Typke, P. G. W., F.I.C., Lawn House, New Malden, Surrey
1876			Tyrer, Thomas, Stirling Chemical Works, Abbey-lane, Stratford, E.
1903			Tyrrell, Dennis, 182, King-street, Norwich
1885			Tyson, Thomas B., 4, Fernhill-terrace, New Quay, Cornwall
1876			‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffs.
1865			Umney, Charles, F.I.C., 50, Southwark-street, S.E.
1893	Trans.		Umney, John C., 50, Southwark-street, S.E.
1889			‖Underhill, Thomas J., 73, Pepys-road, New Cross, S.E.
1904			Underhill, William Wood, 10, Hartham-road, Holloway, N.
1897			‖Unwalla, R. N., Medical Dept., Bhaunagar, Kathiawâr, India
1882			‖Vacher, Francis.
1890			Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1903			Van Laer, Norbert, c/o Messrs. Truman, Hanbury, Buxton and Co., Ltd., Burton-on-Trent
1901			Varley, Harold F. F., St. John's College, Green-lanes, Finsbury Park, N.
1883			Vasey, S. A., F.I.C., Beechcroft, Burnt Ash-lane, Bromley, Kent
1882			Vasey, Thomas E., P.O. Box 1149, Montreal, Canada
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor Herbert, M.A., D.Sc., F.R.S., 20, Bradmore-road, Oxford
1891			Velling, F. W. de, B.A., High Grade Board School, The Boulevard, Hull
1881			Venable, Frank P., Ph.D., Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas J. M., Apartado No. 237, Bogotá, Colombia
1901			Verteuil, Joseph de, Clarence-st., Port of Spain, Trinidad, B.W.I.
1897			Viccajee, F. K., H.H. The Nizam's Mint, Hyderabad, Deccan, India
1897			Vinter, P. J., M.A., 33, Lynton-road, Acton, W.
1884			‖Voelcker, Edward William, A.R.S.M., F.I.C., 22, Tudor-street, Blackfriars, E.C.
1884		C 1891-5 1902-04	‖Voelcker, John Augustus, M.A., Ph.D., B.Sc., F.I.C., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖Voss, Walter Arthur, Melrose, Whitworth-road, S. Norwood, S.E.
1885			Vulté, Hermann T., Ph.D., Columbia University, New York City, U.S.A.
1901			‖Wade, Frank, A.R.C.S., A.I.C., 44, Beach Farm-road, Southsea and Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.		Wade, John, D.Sc. (Lond.), F.I.C., 7, Trinity-square, Southwark, S.E., and Guy's Hospital, London Bridge, S.E.

Date of Election.			
1903	Trans.		Wadmore, John Mello, B.A. (Oxon.), Aldenham School, near Elstree, Herts.
1901			Wager, Morton, B.Sc., 63, Dark-lane, Batley, Yorks.
1894			‖Wagner, W. G., Glyndhurst, Ealing Common, W.
1902			Wain, William C., Explosives Department, Sydney, N.S.W.
1884			Wainwright, J. Howard, Ph.D., 159, Front-street, New York City, U.S.A.
1893			Wait, Charles E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada
1897			Waite, W. H., M.A., Park-road, Halifax
1899			Walden, Allan F., M.A., 37, High-street, and New College, Oxford
1897			Walford, S. M., Wyncote, Hatherlow, Stockport
1868			‖Walker, Alexander, Major-General, C.S.I., R.A.
1881			‖Walker, Archibald, M.A., 8, Crown-terrace, Dowanhill, Glasgow
1898			Walker, Andrew Jamieson, Ph.D., B.A., Municipal Technical College, Derby
1900			Walker, Augustus John, 1, Linton-road, Hastings
1899			Walker, Charles, c/o T. B. Walker, Esq., School of Mines, Charters Towers, Queensland, Australia
1894	Trans.		Walker, Charles H. H., M.A., Secondary School, Oldbury, Birmingham
1889			Walker, Daniel, School of Mines, Ballarat, Victoria, Australia
1890	Trans.	C. 1899-04.	‖Walker, James, Prof., D.Sc., Ph.D., F.R.S., 8, Windsor-terrace, Dundee
1890			Walker, James Samuel Hourston, M.B., C.M., Clinical Research Association, 1, Southwark-street, S.E.
1897	Trans.		Walker, James Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1865	Trans.		‖Walker, John Francis, M.A., F.I.C., 45, Bootham, York ; and Sidney Sussex College, Cambridge
1888			Walker, J. T. Ainslie, 6, Selwyn-road, Upton Manor, E.
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey, Manchester
1898			Walker, Samuel, M.A., D.Sc., 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1904			Walker-Pole, Miles, 71, De Korte-street, Braamfontein, Johannesburg, South Africa
1901			Wallace, H. G., Blenheim Club, 12, St. James's-square, S.W.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, Ph.D., 7, Franklin-place, Morristown, N.J., U.S.A.
1898			Waller, H. F., Iron Mountain, Keswick, California, U.S.A.
1904			Walling, Léon Edward, 43, Union-road, Rotherhithe, S.E.

Date of Election.			
1902			‖Wallis, Thomas Edward, B.Sc. (Lond.), A.I.C., 78, Essex-road, Islington, N.
1883			‖Walmsley, R. Mullineux, D.Sc., Northampton Institute, St. John Street-road, Clerkenwell, E.C., and 23, Hilldrop-road, Camden Town, N.W.
1888			Walrond, Edward Dalrymple, B.A., North Eastern Counties School, Barnard Castle, Durham
1903			Walsh, Thomas Crosbie, Casilla 12, Antofagasta, Chile, South America
1899			Walton, Robert Hawks, Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884			‖Walton, Thomas Ulrick, B.Sc., F.I.C., Colonial Sugar Refining Co., Sydney, N.S.W.
1864			Ward, George, F.I.C., Buckingham-terrace, Headingley, Leeds
1895			Ward, G. J., Hallam Fields, Ilkeston
1891			Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875			Wardle, Sir Thomas, F.G.S., Leek, Staffs.
1863	Trans.	C. 1874-6 78-82. V.P. 89-93.	‖Warington, Robert, Prof., M.A. (Oxon.), F.R.S., High Bank, Harpenden, Herts.
1871			Warner, George Joseph, Halton Villa, Widnes
1888			Warrick, Frederic Walmsley, 6, Nile-street, City-road, N.
1887	Trans.		Warrington, Arthur Walley, M.Sc., Craven Lodge, Rainhill
1895			Warrington, T. C., 29, Stockwell-street, Leek, Staffs.
1882			Waterfall, Charles J., 4, Queen-square, Bristol
1901			‖Waterhouse, James, Major-General, I.S.C., Oak Lodge, Court-road, Eltham, Kent
1894			Waterhouse, Robert, 7, Lyme-grove, Altrincham, Cheshire
1893			Watson, A. Forbes, B.Sc., Laboratory, Watling-street, Dublin
1885			Watson, Charles, Dawsholm Chemical Works, Maryhill, Glasgow
1887			‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1899			Watson, Fred Sheasby, B.Sc., Stoneleigh, New Mills, Derbyshire
1883			‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1876			‖Watson, W. H., J.P., Steelfield Hall, Gosforth, Cumberland
1877			Watt, Alexander, c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1904			Watt, Francis Langston, Russenden, Stanley-street, Epping, near Sydney, N.S.W.
1897			Watts, C. T. F., B.Sc., 2, Clauson-villas, Beckenham-road, Beckenham
1883	Trans.		Watts, The Hon. Francis, D.Sc. (Birm.), Government Laboratory for the Leeward Islands, Antigua, W.I.
1872	Trans.		‖Watts, John, M.A. (Oxon.), D.Sc. (Lond.), Merton College, Oxford
1878	Trans.		Watts, John I., Fairleigh, Hartford, Cheshire

Date of Election.		
1888		Way, Edward John, F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal, South Africa
1901		Wayland, W. A., 12, Albert-road, St. John's, S.E.
1902		Webb, A. J., B.Sc., 21, Hammelton-road, Bromley, Kent
1883	Trans.	Webster, C. S. Stanford, F.I.C., Malvern House, Redland, Bristol
1866		Webster, G. W., 31, Bridge-street-row, Chester
1877		Webster, William, 50, The Park, Blackheath, S.E.
1904		Weinberg, John, Rosa Sugar Works and Distillery, Rosa United Provinces, India
1904		Weiss, Carl Friederich Richard, M.A., Ph.D. (Bâle), Langdon House, Park-crescent, Victoria-park, Manchester
1898		Weissmüller, Edward Charles, 8, Stanley Villas, Greenway-road, Runcorn
1901		Welch, G. E., B.Sc., Grammar School, Wakefield
1888		Welch, J. Cuthbert, Montreal and Boston Copper Co., Ltd., Boundary Falls, British Columbia
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen N., c/o The Gas and Water Co., Ltd., Colombo, Ceylon
1884	Trans.	Wells, James S. C., Ph.D., Columbia University, New York City, U.S.A.
1902		Wells, John W., M.D., C.M., Springburn, Montague-street, Blackburn
1890		Wells, S. Russell, B.Sc., M.D. (Lond.), M.R.C.S., M.R.C.P., 24, Somerset-street, Portland-place, W.
1903		Welsford, Giles Haddon, Royal Gunpowder Factory, Waltham Abbey, Essex
1897		Welsh, John, M.R.C.S., L.R.C.P., 43, Tarvin-road, Chester
1888	Trans.	Werner, Emil A., F.I.C., 5, Church-avenue, Rathmines, Dublin
1886		Wertheimer, Julius, Prof., B.A., B.Sc., F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, Charles Alfred, A.R.C.S., F.I.C., 95, Oakhill-road, East Putney, S.W.
1899		West, George H., B.Sc., County School, Pembroke Dock
1902		West, Joseph, 50, Poplar-grove, Fenton, Stoke-on-Trent
1898		Weston, F. E., 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry A., c/o Messrs. Parke, Davis & Co., P.O. Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence J. de, 172, Erlanger-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc. (Lond.), 18, Nevilledale-terrace, Durham
1902		Wheeler, Edward J., Ph.D., 79, Chapel-street, Albany, N.Y., U.S.A.
1894		Wheeler, H. L., Ph.D., The Sheffield Laboratory, New Haven, Conn., U.S.A.

Date of Election.		
1893		‖Wheeler, William Ernest, 40, Gillott-road, Edgbaston, Birmingham
1897		Wheelwright, E. W., B.A., Ph.D., F.I.C., Greenholme, Westfield-road, Acock's-green, near Birmingham
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford, Yorks.
1897		White, Arthur James, 243, Albert-road, Jarrow-on-Tyne
1899		White, Arthur Lee, A.R.C.S., B.Sc., F.I.C., 95, Effingham-road, St. Andrew's-park, Bristol
1893		White, H. C., Prof., University, Athens, Georgia, U.S.A.
1891		White, Henry, 245, Western-road, Crookes, Sheffield
1899		White, H. Fox, 52, Royal York-crescent, Clifton, Bristol
1889		‖White, John Tsawoo, M.A., F.I.C., Pyinmana, Upper Burma, India
1862		White, Leedham, 16, Wetherby-gardens, S.W.
1897		White, P. T., Horton Field, West Drayton, Middlesex
1903		White, William Carter, 58 and 59, Bunhill Row, E.C.
1893		White, William Gilchrist, 86, Bay-street, Port Glasgow, N.B.
1885		Whitehead, Henry H., Holland House, Spring-grove, Isleworth, W,
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, P. L., 10, Victoria-street, West Bromwich, Staffs.
1889		Whitehouse, William, Albany House, Bradmore, Wolverhampton
1904	Trans.	Whiteley, Charles Edward, 9, Abyssinia-grove, Leeds
1886	Proc.	Whiteley, Richard Lloyd, F.I.C., 5, Bagnall-street, W. Bromwich
1892		Whiteside, John Lowe, 376, St. Helen's-road, Bolton
1863		‖Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, C. J., West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, Ansdell, Lytham
1889		Whittam, Matthew, M.A., 68, St. Peter's-road, Leicester
1901		Whittle, James, 30, Bridge-street, Morpeth
1901		Whitton, William Arthur, The Bristol Pure Beer Co., Ltd., Victoria-street, Bristol
1900		Wiechmann, F. G., Ph.D., P.O. Box 79, Station W., Brooklyn, New York, U.S.A.
1889		Wigan, Basil P., Rhondda Valley Brewery Co., Treherbert
1896	Proc.	Wigner, J. H., Ph.D., University College, Dundee
1896		Wilcox, A. J., The Laurels, Junction-road, Great Warley, Essex
1891		‖Wild, John, B.Sc., A.I.C., Bredbury House, Bredbury, Stockport
1898		‖Wild, W. E., B.Sc., Clifton-villas, Fairvel-road, Glossop
1898		Wilder, F. L., Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans.	Wilderman, Meyer, Ph.D., B.Sc., Davy-Faraday Laboratory, Albemarle-street, W.
1881		Wilkes, J. P., 54½, Old Broad-street, E.C.
1902	Trans.	Wilkinson, Edward John, 8, Blenheim-terrace, Leeds
1904		Wilkinson, James Alfred, M.A. (Cantab.), Transvaal Technical Institute, P.O. Box 3572, Johannesburg, South Africa

Date of Election.		
1903		Wilkinson, James Bates, M.D., C.M., D.P.H., Town Hall, Oldham
1893		Wilkinson, John, Corporation Gas Works, Halifax
1891		Will, Wilhelm, Prof., Ph.D., Colonie Grunewald, Boothstrasse 32, bei Berlin
1885		Will, Wm. Watson, 1, St. Agnes-place, Kennington Park, S.E.
1862	Trans.	‖Williams, C. Greville, F.R.S., F.I.C., 21, Bournevale-road, Streatham, S.W.
1903		Williams, David John, 1, St. Agnes-place, Kennington Park, S.E.
1895		Williams, Evan, Bradford-road Gas Works, Manchester
1892		Williams, John, Government Laboratory, British Guiana
1883	Proc.	Williams, Rowland, Hale Cote, Haverbreaks, Lancaster
1891		Williams, Seward W., c/o Messrs. Seabury and Johnson, 8, Brighton-avenue, East Orange, New Jersey, U.S.A.
1872		‖Williams, Thomas, Chemical Laboratory and Assay Office, 8, Victoria-street, Liverpool
1885	Trans.	‖Williams, Walter Collingwood, B.Sc., 68, Grove-street, Liverpool
1892		Williams, William, County Offices, Westgate-street, Cardiff, and 63, Plymouth-road, Penarth
1899	Proc.	Williams, William Arthur, c/o Mr. Smith, 17, Bruntsfield-gardens, Edinburgh
1874	Trans.	‖Williams, William Carleton, B.Sc., 23, Broomgrove-road, Sheffield
1898		Williamson, J. A., 14, Milton-avenue, Highgate, N.
1874	Trans.	‖Williamson, Robert, Low Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Ph.D. (Munich), Faireholme, Esher, Surrey
1898		Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1896		Wills, E. Chaning, M.A. (Cantab.), Eastdown House, East Down, Barnstaple
1872		Wills, Joseph Lainson, 133, Midwood-street, Flatbush, Brooklyn, New York, U.S.A.
1903		Wilmore, Albert, Municipal Technical School, Colne, Lancs.
1892	Trans.	Wilsmore, N. T. M., University College, Gower-street, W.C.
1885		Wilson, A. C., F.R.S.E., Borough Hall, Stockton-on-Tees
1879		‖Wilson, Charles J., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, D.Sc., Carbeth, Killearn, Glasgow
1901		‖Wilson, Duncan, Magdalen College, Oxford
1899		Wilson, F. R. Leyland, M.A., Charterhouse, Godalming
1895		Wilson, Harry, F.I.C., 146, High-street, Southampton
1875		‖Wilson, James, M.A., Barrister-at-Law, 2, Essex-court, Temple; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, F.I.C., 6, Fenchurch-buildings, E.C.
1890		Wilson, James Mitchell, M.D., C.M., County Hall, Beverley
		Wilson, James Scott, M.D., C.M., D.P.H., Bradford-street, Walsall
	Proc.	Wilson, John, M.Sc., Battersea Polytechnic, S.W.

Date of Election.		
1899		Wilson, John, 153, Buckley-street, Foots Cray, Victoria, N.S.W.
1891		Wilson, John Henry, A.I.C., Glenthorn, Northumberland-road, Coventry
1902		Wilson, Lyndon C., 31, Castle-gate, Newark-on-Trent
1900	Proc.	Wilson, L. P., Stocksfield, Church-road North, Hanwell, W.
1871		‖Wilson, William John, c/o Paget Prize Plate Co., Watford
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich
1874		Wiltshire, Thomas Pemberton, c/o Tartar Chemical Company, 9th-street and Gowanus Canal, Brooklyn, New York, U.S.A.
1893		Winder, Edward Humphreys, c/o Dr. W. H. Winder, H.M. Convict Prison, Aylesbury
1894		Wingate, Hamilton M., B.Sc., 90, Queenswood-road, Forest Hill, S.E.
1895		Wingfield, T. R., 5, Bromwich-street, Bolton
1876		Winser, Percy James, Moor House, Biddulph Moor, Congleton
1898	Trans.	Witham, Ernest, B.A., B.Sc. (Lond.), The Grammar School, Rotherham
1876	Trans.	‖Witt, Otto N., Geh. Rath, Prof., Ph.D., 21, Siegmundshof, Berlin, W.
1896		Wolfenden, J. H., B.Sc., 13, Pole-lane, Failsworth, Manchester
1902		Womersley, Charles Edward, 17, Kilpin-hill, near Dewsbury
1889		Wood, Charles, Rossemount, Emm-lane, Heaton, Bradford
1860	Trans.	‖Wood, Charles Henry, Erica, Poole-road, Parkstone, R.S.O., Dorsetshire
1902		Wood, Frank S , 25, Suffolk-Street, Newland, Hull
1898	Trans.	Wood, T. B., M.A., Gonville and Caius College, Cambridge
1903		‖Wood, William Francis John, B.Sc. (Lond.), Hazelhurst, Doncaster-road, Barnsley
1884	Proc.	Wood, William H., B.A. (Oxon.), La Martinière, Calcutta
1900		Woodbridge, Walter Bourne, A.C.G.I., Grey Friars, Chichester
1871	Trans.	Woodcock, Reginald C., The Sanitas Co., Ltd., 636 to 642, West 55th-street, New York City, U.S.A.
1904		Woodcock, William Henry, 10, Chesson-road, W. Kensington, W.
1898		Woodhead, S. A., B.Sc., Agricultural College, Uckfield, Sussex
1892		‖Woods, Hugh, 26, Welbeck-street, W.
1888		Woodward, James, B.A., B.Sc., F.I.C., Drummond House, 31, Coventry-road, Ilford, Essex
1889		Woolf, Mortimer, Mayfield, Mortimer-road, N.W.
1903		Woolhouse, Sidney Herbert, M.A., B.Sc., A.R.C.S., 2, Durham-road, Lower Edmonton, N.
1889		Woosnam, Richard William, F.I.C., 1, The Chase, Warby Mount, Brentwood, Essex

Date of Election.			
1903			Worden, Edward Chauncey, Clark Thread Co., Newark, New Jersey, U.S.A.
1899			Wormell, Thomas Wilson, B.Sc., 22, Nevill-road, Bishopston, Bristol
1884			‖Worrall, J. Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858	Trans.		‖Worsley, Phillip J., Rodney Lodge, Clifton, Bristol
1898			Wrench, C. A., 95A, Southwark-street, S.E.
1904			Wright, Fred., c/o Messrs. Elliott Bros., O'Connell-street, Sydney, N.S.W.
1895			Wright, Harold E., c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1900			Wright, Herbert Edwards, M.A., c/o H. Russell Wright, Esq., The Grammar School, Northwich, Cheshire
1878	Trans.		Wright, Lewis Thompson, 10, Linden-gardens, Bayswater, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		Wright, William T., 16, Montgomery-road, Sheffield
1864			‖Wrightson, John, Prof., College of Agriculture, Downton, Salisbury
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, W. Fitzthomas, Wheatley-street, Coventry
1901			Wylie, A. S., 11, Trinity-road, Folkestone
1885	Trans.	C. 1892-6, S.1898-99, 1903-	Wynne, William Palmer, Prof., D.Sc. (Lond.), F.R.S., F.I.C., A.R.C.S., University College, and 106, Whitham-road, Sheffield
1874	Trans.		Yates, Robert, St. Hilda, Elsworthy-road, Regent's Park, N.W.
1903			Yeomans, Williams Wade, c/o Messrs. Schoellköpf, Hartford and Hanna Co., Chemical and Aniline Color Manufacturers, Buffalo, New York, U.S.A.
1886	Trans.		Yoshida, Hikorokurō, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred C., 53A, Algiers-road, Ladywell, S.E.
1903			Young, Andrew, M.A., B.Sc., Geological Department, South African College, and 1, Avenue-terrace, Cape Town, South Africa
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, Francis Samuel, M.A., F.I.C., Nonconformist Grammar School, Bishop's Stortford
1877			‖Young, Frank W., F.R.S.E., H.M. Inspector of Science and Art Classes, 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D., 38, Rutland-Park, Sheffield
1895			Young, Henry Stow, c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 4, Plumstead Common-road, Woolwich, S.E.

Date of Election.			
1877			‖Young, J. Rymer, 42, Sankey-street, Warrington
1874			Young, John, 164, Bath-street, Glasgow
1898			Young, J. H., B.Sc., c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1887	Trans.		Young, John William, B.A., B.Sc., 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc., F.R.S., Trinity College, Dublin
1902			Young, Thomas A., 318, Cheetham-hill-road, Manchester
1873			‖Young, W. C., Normanhurst, High-road, Romford ; and Chemical Laboratory, 19/20, Aldgate, E.C.

Number of Honorary and Foreign Members ... **35**

,, ,, Fellows **2,707**

R. CLAY AND SONS LTD., BREAD STREET HILL, E.C., AND BUNGAY, SUFFOLK.

PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XXI. Nos. 288—302.
JANUARY—DECEMBER, 1905.

LONDON:
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1906.

Richard Clay and Sons, Limited,
BREAD STREET HILL, E C., AND
BUNGAY, SUFFOLK.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR 1905.

£10 to E. F. Armstrong, for the investigation of the synthesis of maltose, *iso*maltose, lactose, and kindred sugars.

£5 to W. C. Ball, for the investigation into the preparation of complex metallic salts and the conditions of their decomposition by heat.

£15 to E. C. C. Baly, for the investigation of the ultra-violet absorption spectra of organic compounds.

£5 to J. B. Cohen, for the continuation of his investigation on the chlorination and bromination of the aromatic hydrocarbons.

£5 to A. Findlay, for the investigation of the saponification velocities and freezing-point curves.

£10 to F. E. Francis, for the investigation of the action of nitrogen sulphide on organic and inorganic substances.

£3 to J. A. N. Friend, for the investigation of the decomposition of hydrogen peroxide by colloidal platinum.

£5 to J. A. Gardner, for the investigation of hydroxy-compounds obtained from camphopyric acid.

£10 to A. G. Green, for the investigation of the constitution of synthetic dye-stuffs.

£3 to P. Haas, for the investigation of the nitrogen derivatives of dimethyldihydroresorcin.

£5 to J. Hawthorne, for the investigation of the constitution of acidyl thiocyanates.

£10 to F. W. Kay, for the investigation of tetrahydro-*p*-toluic acid.

£10 to T. M. Lowry, for the continuation of his investigations of dynamic isomerism.

£10 to A. McKenzie, for the continuation of his investigations in asymmetric synthesis.

£5 to T. S. Moore, for the investigation of tautomerism.

£10 to R. S. Morrell and E. K. Hanson, for the continuation of the investigations of β-crotonic acid.

£5 to R. H. Pickard, for the investigation of a new method of measuring hydroxyl ions.

£10 to R. H. Pickard, for the continuation of his investigations on optically active carbimides.

£10 to R. Robinson, for the investigation of ethyl piperonylacetate.

£10 to S. Ruhemann, for the investigation of the action of acid chlorides of acetylenic acid on ketonic compounds.

£5 to S. Ruhemann, for the continuation of his investigation on tetrazoline derivatives.

£5 to Miss A. E. Smith, for the study of the transformations and decompositions of *s*-tribromonitroaminobenzene.

£5 to A. W. Stewart, for the investigation of "Steric Hindrance" applied to bisulphite derivatives of ketones.

£20 to J. J. Sudborough, for the continuation of his investigation on "Steric Hindrance" and polynitro-compounds.

£10 to G. Tattersall, for the investigation of the synthesis of carvestrene.

£15 to J. F. Thorpe for the investigation of the preparation of substituted aconitic acids by condensation of ethyl cyanoacetate with ethyl oxalacetate.

£20 to A. E. H. Tutton, for the investigation into the relations between crystallographic form and chemical composition.

LIST OF FELLOWS ELECTED DURING 1905.

Name.	Proposed.	Elected.
Adam, Adam Lawson Kelly	November 2nd, 1905.	December 7th.
Ahlum, C. Chester	,, ,, ,,	,, ,,
Alcock, James Edward	,, ,, ,,	,, ,,
Allison, James Albert	,, ,, ,,	,, ,,
Amos, Arthur	February 15th, 1905.	May 4th.
Andrews, Albert Edward	April 6th, 1905	,, ,,
Angel, Andrea	December 1st, 1904	February 15th.
Anthony, Charles	November 16th, 1905.	December 7th.
Arnaud, Francis William Fredk	November 16th, 1904.	February 15th.
Ashwell, James Henry	January 18th, 1905	,, ,,
Barbrook, George Henry	November 2nd, 1905.	December 7th.
Barnes, James Hector	December 14th, 1904.	February 15th.
Barrowcliff, Marmaduke	November 2nd, 1905.	December 7th.
Baxter, John George	March 2nd, 1905	May 4th.
Bealey, Edward Williams	May 17th, 1905	June 14th.
Bees, William James	,, ,, ,,	,, ,,
Belton, Francis George	April 6th, 1905	May 4th.
Bennett, Joseph	April 19th, 1905	June 14th.
Bousfield, William Robert	May 17th, 1905	,, ,,
Brettell-Vaughan, Edward Shipley Hewett Edwards	April 6th, 1905	May 4th.
Briggs, Samuel Henry Clifford	January 18th, 1905	February 15th.
Brown, John Coggin	November 2nd, 1905.	December 7th.
Burt, Bryce Chudleigh	June 1st, 1905	,, ,,
Campbell, Eric William	May 4th, 1905	June 14th.
Campbell, James H.	December 1st, 1904	February 15th.
Chatterji, Hem Chandra	December 14th, 1904.	,, ,,
Clark, Friend E.	January 18th, 1905	,, ,,
Clark, Thomas Walter Firth	April 6th, 1905	May 4th.
Clarkson, George Douglas	November 16th, 1904	February 15th.
Coates, Joseph Edward	November 2nd, 1905.	December 7th.
Colles, William Morris	February 15th, 1905.	May 4th.
Collitt, Bernard	December 1st, 1904	February 15th.
Coupe, Miles	February 15th, 1905.	May 4th.
Cowie, William Beaverly	May 17th, 1905	June 14th.
Cowman, Douglas Henry Bellars	November 2nd, 1905.	December 7th.
Dallman, Arthur Augustine	,, ,, ,,	,, ,,
Davey, Joseph Morgan	June 1st, 1905	,, ,,
Davies, John Llewelyn	November 2nd, 1905.	,, ,,
Day, William Walpole	May 17th, 1905	June 14th.
De Lury, Ralph Emerson	April 19th, 1905	,, ,,
Dodds, Roger	March 2nd, 1905	May 4th.
Donald, Robert	April 19th, 1905	June 14th.
Doull, John	November 2nd, 1905.	December 7th.

Name.	Proposed.	Elected.
Dunlop, Harry	June 14th, 1905	December 7th.
Dunstan, Sydney	March 2nd, 1905	May 4th.
Eade, Samuel George	November 16th, 1904.	February 15th.
Evans, Bernard Scott	February 2nd, 1905	May 4th.
Ferrier, John Greig	,, ,, ,,	,, ,,
Findon, Frank Standish	March 15th, 1905	,, ,,
Finnemore, Horace	April 6th, 1905	,, ,,
Forster, Ernest Lyle Carman	April 19th, 1905	June 14th.
Gall, John Beaconsfield	November 2nd, 1905.	December 7th.
Gardner, Charles Richard	January 18th, 1905	February 15th.
Gillies, Albert	March 2nd, 1905	May 4th.
Glass, Archibald Melville	February 2nd, 1905	,, ,,
Goodier, Herbert	December 1st, 1904	February 15th.
Gorman, Henry Isaac	March 2nd, 1905	May 4th.
Green, Ernest	,, ,, ,,	,, ,,
Griffiths, John	April 6th, 1905	,, ,,
Groves, Samuel Ernest	February 2nd, 1905	,, ,,
Haig, Sidney Montague	November 2nd, 1905.	December 7th.
Hart, Alfred	,, ,, ,,	,, ,,
Hawthorne, John	March 2nd, 1905	May 4th.
Hayman, Jack Vernon Johnson	November 2nd, 1905.	December 7th.
Heely, Frederick William	January 18th, 1905	February 15th.
Henderson, James Alexander Russell	,, ,, ,,	,, ,,
Hennings, Carl Richard	November 16th, 1904.	,, ,,
Henstock, Herbert	May 17th, 1905	June 14th.
Hetherington, Arthur Lonsdale	March 2nd, 1905	May 4th.
Higgins, John Michael	November 2nd, 1905	December 7th.
Hill, William Basil	,, ,, ,,	,, ,,
Hobsbaum, Isaac Berkwood	,, ,, ,,	,, ,,
Hollins, Cecil	,, ,, ,,	,, ,,
Howgate, James Henry	April 6th, 1905.	May 4th.
Jack, Maurice Brooks	November 2nd, 1905.	December 7th.
Jarrard, William John	May 17th, 1905	June 14th.
Jones, Bernard Mouat	December 14th, 1904.	February 15th.
Jones, Edward Towyn	November 2nd, 1905.	December 7th.
Jones, Percy Walter	January 18th, 1905	February 15th.
Jones, Tudor Foulkes	November 16th, 1904.	,, ,,
Kay, Sydney, A.	March 2nd, 1905	May 4th.
Killby, Leonard Gibbs	,, ,, ,,	,, ,,
Law, Herbert Drake	June 1st, 1905.	December 7th.
Leech, Herbert Louis	December 14th, 1904.	February 15th.
Leek, William Henry	April 6th, 1905	May 4th.
Lewis, Ernest Isaac	March 2nd, 1905	,, ,,
Lister, Joseph	January 18th, 1905	February 15th.
Lloyd, George Moss	December 1st, 1904	,, ,,
Lucas, Edward William	January 18th, 1905	,, ,,
Luck, Alfred Courtenay	December 14th, 1904.	,, ,,
Lyon, Rudolph	November 2nd, 1905.	December 7th.

Name.	Proposed.	Elected.
McCleary, William	November 2nd, 1905.	December 7th.
MacKechnie, Robert Drysdale	,, ,, ,,	,, ,,
Maguire, Peter	February 2nd, 1905	May 4th.
Marle, Ernest Robert	,, ,, ,,	,, ,,
Martin, Francis Grimshaw	April 6th, 1905	,, ,,
Martin, Harry	November 2nd, 1905.	December 7th.
Mason, Arthur Walter	May 17th, 1905	June 14th.
Maughan, Reginald Bruce	March 15th, 1905	May 4th.
Meldrum, Andrew Norman	December 14th, 1904.	February 15th.
Micklewright, Harry George Fletcher	November 2nd, 1905.	December 7th.
Millen, John Dunlop	November 16th, 1905.	,, ,,
Mills, William Sloan	November 16th, 1904.	February 15th.
Modi, Edalji Manekji	November 2nd, 1905.	December 7th.
Moore, Charles Watson	December 14th, 1904.	February 15th.
Morris, Eric Haydn-	June 14th, 1905	December 7th.
Morris, Edwin	March 15th, 1905	May 4th.
Mortimer, Alfred	April 6th, 1905	,, ,,
Motion, John	November 2nd, 1905.	December 7th.
Neville, Henry Allen Dugdale	,, ,, ,,	,, ,,
O'Farrelly, Alfons	March 2nd, 1905	May 4th.
Penn, Francis Richard	November 2nd, 1905.	December 7th.
Pennycuick, Thomas	December 1st, 1904	February 15th.
Perkins, Hugh Donald	November 2nd, 1905.	December 7th.
Perrott, Bert	December 1st, 1904.	February 15th.
Phipson, Percy Barker	November 2nd, 1905.	December 7th.
Pooler, Frederick John	,, ,, ,,	,, ,,
Pymán, Frank Lee	January 18th, 1905	February 15th.
Quant, Ernest	December 14th, 1904.	,, ,,
Ratcliffe, William Henry	December 1st, 1904	,, ,,
Richards, Frederick George	,, ,, ,,	,, ,,
Rigby, Thomas	June 1st, 1905	December 7th.
Rogers, Harold Rudolph	December 1st, 1904	February 15th.
Ross, Frederick Wilson Montrose	May 17th, 1905	June 14th.
Rowland, James Frederick Fothergill	November 2nd, 1905.	December 7th.
Rowley, Henry	November 16th, 1905	,, ,,
Royle, Harold Marmion	November 2nd, 1905.	,, ,,
Ruston, Arthur Gough	June 1st, 1905	,, ,,
Sarginson, William	March 2nd, 1905	May 4th.
Schnurmann, Harry Nestor-	November 2nd, 1905.	December 7th.
Scholefield, Fred	January 18th, 1905	February 15th.
Scott, John Irwin	,, ,, ,,	,, ,,
Schröder, Harold	November 16th, 1904	,, ,,
Seaton, William Dunham	January 18th, 1905	,, ,,
Setterington, Douglas Temple	November 2nd, 1905.	December 7th.
Shedden, Frank	March 15th, 1905	May 4th.
Shepherd, Charles Stuart	February 2nd, 1905	,, ,,
Simmons, William Herbert	January 18th, 1905	February 15th.
Speight, William Ewart	February 2nd, 1905	May 4th.
Spencer, Arthur Gordon	March 15th, 1905	,, ,,
Steger, James	May 17th, 1905	June 14th.
Stennitt, Sydney Dockeray	April 6th, 1905	May 4th.

Name.	Proposed.	Elected.
Stevens, Edmund Henry..........	April 6th, 1905	May 4th.
Stevens, Harold Blythen....................	,, ,, ,,	,, ,,
Swann, Robert Reed	March 2nd, 1905......	,, ,,
Taylor, John William	February 15th, 1905..	,, ,,
Thomas, George Devenish	March 15th, 1905 ...	,, ,,
Tillot, John Booty	November 2nd, 1905.	December 7th.
Titherley, Arthur Walsh	February 2nd, 1905...	May 4th.
Troye, Gustav Arthur........................	December 14th, 1904.	February 15th.
Tuck, William Bradshaw	May 17th, 1905	June 14th.
Tutin, Frank....................................	November 2nd, 1905.	December 7th.
Wall, Francis Henry	April 6th, 1905	May 4th.
Walpole, George Stanley......	November 2nd, 1905.	December 7th.
Want, William Phillip	December 14th, 1904	February 15th.
Weiskopf, Eric H.............................	January 18th, 1905...	,, ,,
Wheeler, Ernest	November 16th, 1904.	,, ,,
White, John Ledger..........................	November 2nd, 1905.	December 7th.
White, John William	May 17th, 1905	June 14th.
Wigginton, John Henry Becker...........	November 16th, 1904	February 15th.
Wilkinson, John Wells	December 14th, 1904.	,, ,,
Williams, Alan Herbert...	,, ,, ,,	,, ,,
Williams, Gerard William	November 2nd, 1905 .	December 7th.
Wren, William James	May 17th, 1905	June 14th.

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Name.	Elected.	Died.
Ackroyd, William	June 17th, 1897	May 9th, 1905.
Blades, Charles Mountain	March 5th, 1885	January 25th, 1905.
Braga, John Francis	March 17th, 1881	January 7th, 1905.
Buckton, George Bowdler	March 1st, 1852	September 25th, 1905.
Bullock, John Lloyd	December 20th, 1842	June 3rd, 1905.
Burnard, Charles Frederick	March 19th, 1849	November 10th, 1905
Calvert, Jonathan Hindle	December 21st, 1871	June 16th, 1905.
Carpenter, Henry Sanders	May 6th, 1875	September 23rd, 1904.
*Cleve, Per Theodor	February 1st, 1883	June 18th, 1905.
Duncan, James	December 17th, 1863	August 12th, 1905.
Elworthy, Herbert Samuel	March 4th, 1886	November 8th, 1905.
Epps, James	December 3rd, 1885	February 20th, 1905.
Graham, Edward	December 5th, 1895	August 20th, 1905.
Greenwood, William Henry	May 15th, 1873	October 31st, 1905.
Harrold, Frederick William	February 19th, 1891	November 26th, 1905.
Mercer, Francis Montier	December 18th, 1884	January 7th, 1905.
Prasad, Mata	December 3rd, 1903	December 15th, 1904.
Prescott, Albert Benjamin	March 2nd, 1876	February 25th, 1905.
Rickard, William Thompson	February 3rd, 1845	March 28th, 1905.
Roose, Robson	April 15th, 1886	February 12th, 1905.
Shapley, Frederick	December 7th, 1893	August 28th, 1903.
Sutton, Charles William	February 21st, 1884	May 14th, 1904.
Tichborne, Charles Richard Clarke	February 19th, 1863	May 1st, 1905.
White, Leedham	March 20th, 1862	January 26th, 1905.
Will, William Watson	December 17th, 1885	December 12th, 1905.
Yates, Robert	June 4th, 1874	April 18th, 1905.

* Honorary and Foreign Member.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. **No. 288.**

Wednesday, January 18th, 1905. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. T. R. Hodgson, J. K. H. Inglis, J. R. Johnson, and G. F. Phillips were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

James Henry Ashwell, 117, Waterloo Crescent, Nottingham.
Samuel Henry Clifford Briggs, B.Sc., Green Bank, Cleckheaton, Yorks.
F. E. Clarke, Ph.D., B.Sc., Pennsylvania State College, Pa., U.S.A.
Charles Richard Gardner, Green Cottage, Brunswick Square, Gloucester.
Frederick William Heely, 10, Yarborough Street, Grimsby.
James Alexander Russell Henderson, B.Sc., Chihli Provincial College, Paotingfu, N. China.
Percy Walter Jones, Toowong, Brisbane, Queensland.
Joseph Lister, B.Sc., 50, Portland Street, Lancaster.
Edward William Lucas, 37, Barton Street, Kensington, W.
Frank Lee Pyman, Ph.D., B.Sc., The Oaks, Hitchin, Herts.
Fred Scholefield, B.Sc., 9, Lyndhurst Villas, Magdalen Road, Norwich.
John Irwin Scott, B.A., Trent College, Long Eaton, Derbyshire.

William Dunham Seaton, 40, Argyle Road, Ilford, Essex.
William Herbert Simmons, B.Sc., Oakleigh, Stoke Newington Common, N.
Eric H. Weiskopf, Modderfontein, Transvaal.

The PRESIDENT gave notice that an EXTRAORDINARY GENERAL MEETING will be held in the Society's Rooms on **Wednesday, February 8th, 1905**, at **5.30 p.m.**, to consider the proposal of the Council to make alterations in the Bye-Laws.

The Council has ordered the following letter and report to be printed in the Journal and in the Proceedings of the Society:

GOVERNMENT LABORATORY,
CLEMENT'S INN PASSAGE,
STRAND, LONDON, W.C.
6th December, 1904.

GENTLEMEN,

I beg to hand you the Report of the International Committee on Atomic Weights, 1905, to which I have appended the names of Professors Moissan and Seubert, as desired by them.

Since the Report was signed I have received, in common I presume with other members of the Committee, a communication from a Committee of the German Chemical Society in reference to the adoption of only one table of numbers in which oxygen should be taken as $O = 16$, to the exclusion of a second table in which the values of the atomic weights were based on $H = 1$. On my communicating with the Chairman as to what action should be taken in consequence of the letter from the Berlin Committee I was informed that the Report as adopted had already been despatched to Japan, and was actually in print in America. In these circumstances, and as the Sub-Committee had not had any opportunity of taking the communication from the German Committee into consideration, he considered it desirable that the Report, as adopted, should be presented to the various Societies concerned.

I am, Gentlemen,
Your obedient Servant,
T. E. THORPE.

The Hon. Secretaries,
The Chemical Society,
Burlington House,
London, W.

Report of the International Committee on Atomic Weights.

The International Committee on Atomic Weights respectfully submits the following report, together with a table of atomic weights for use during 1905.

Most of the values recommended in our table are identical with those reported in former years ; but a few changes seem to be needed. Other changes, which are suggested by recent investigations, are deferred until fuller information regarding their desirability shall have been received. During 1904 there has been great activity in the determination of atomic weights; and a summary of the more important researches may help to explain our reasons for changing or retaining hitherto accepted values. The researches to be considered are as follows :

Glucinum.—Atomic weight redetermined by Parsons (*J. Amer. Chem. Soc.*, 1904, **26**, 721). Seven analyses of the acetylacetonate gave, in mean, Gl = 9·113. Nine analyses of the basic acetate gave exactly the same average. As the individual determinations range from 9·081 to 9·142, the figure 9·1 may evidently remain unchanged.

Indium.—The investigation by Thiel (*Zeit. anorg. Chem.*, 1904, **40**, 280) shows that the atomic weight of indium is higher than had been supposed. Analyses of the trichloride gave, in mean, In = 115·05. Analyses of the tribromide gave 114·81. With the oxide, unsatisfactory results were obtained. For present purposes the round number 115 may be adopted, although further investigation is promised by Thiel, and a research by Dennis and Geer is in progress.

Iodine.—In our former reports we have noted the uncertainty in the accepted atomic weight of iodine. Stas, by the synthesis of AgI, found I = 126·85. Scott, by the same general method, found I = 126·97 ; and Ladenburg, by measuring the ratio AgI : AgCl, obtained the value 126·96. Koethner and Aeuer (*Ber.*, 1904, **37**, 2536), from data given by several methods, including a repetition of Ladenburg's process, conclude that the atomic weight of iodine cannot be less than 126·963 ; but the full details of their investigation, at the date of writing this report, are still unpublished. A more recent research by G. P. Baxter will soon appear, in which the higher value for iodine is completely confirmed, both by Ladenburg's method and by that of Stas. Baxter's final value is I = 126·975 ; and there can now be no reasonable doubt that the Stas figure is too low. The number 126·97 is adopted in our table for O = 16, or 126·01 with hydrogen as unity.

Nitrogen.—The accepted value for the atomic weight of nitrogen, 14·04, is derived mainly from the work of Stas. Of late years, however, the study of gaseous densities has led several physicists, notably Rayleigh, Leduc, and Daniel Berthelot, to the belief that the true value is but little in excess of the round number 14. Guye (*Compt. rend.*, 1904, **138**, 1213) finds from the density of nitrogen the value 14·004. Still more recently, Guye and Bogdan (*ibid.*, **138**, 1494), by analysis of nitrous oxide, have found N = 14·007. Jaquerod and Bogdan (*ibid.*, **139**, 49) have also studied nitrous oxide volumetrically, and obtained the figure 14·019. In view of the discordance between the volumetric and the gravimetric data, it seems undesirable to make any change at present in the number assigned to nitrogen. Further investigation of this atomic weight is evidently needed.

Rubidium.—Atomic weight redetermined by Archibald (*Trans.*, 1904, **85**, 776) from analyses of the chloride and bromide. The final mean, derived from many concordant experiments, is Rb = 85·485. As some of the determinations are slightly higher than 85·5, that figure may be adopted as sufficiently accurate for all practical purposes.

Samarium.—Urbain and Lacombe (*Compt. rend.*, 1904, **138**, 1166), by analyses of the octahydrated sulphate, find Sm = 150·34. A comparison of this figure with the older determinations justifies the use of 150·3 as the most probable value for this atomic weight. The same authors (*ibid.*, **138**, 627) have also determined the atomic weight of europium, and give the figure Eu = 151·79. It is desirable, however, to await more complete information about europium before recognising it in the table.

Thorium.—Evidence as to the complex nature of ordinary "thorium" is steadily accumulating. According to Baskerville (*J. Amer. Chem. Soc.*, 1904, **26**, 922), it is a mixture of at least three elements, which he calls carolinium, thorium, and berzelium. Their approximate atomic weights are 256, 220, and 212·5 respectively, supposing them all to be tetrads. The value in our table is that of ordinary thorium, as it is found in mineral analyses; and no change can safely be made until our knowledge has become more definite.

Tungsten.—The figure commonly assigned to tungsten, W = 184, has been verified by Smith and Exner (*Proc. Amer. Phil. Soc.*, 1904, **43**, 123). From twenty-seven measurements of the ratio $WCl_6 : WO_3$, W = 184·04. From twenty-three syntheses of WO_3, W = 184·065. The individual determinations range from 183·94 to 184·14, which is a fair degree of concordance for so high an atomic weight.

Changes, then, are recommended in the cases of indium, iodine, rubidium, and samarium. The column of atomic weights referred to the hydrogen unit has also been carefully recalculated, and in it some small alterations appear. The latter modifications, however, are unimportant, except in so far as they help to bring the two tables into greater harmony.

During the year, there has been a revival of the agitation over the question of standards; and the policy of this committee, or rather sub-committee of the larger international body, in publishing a double table, has encountered some criticism. That criticism is perfectly legitimate, and we are glad to say that it has been expressed courteously, and in a truly scientific spirit. Professors Sakurai and Ikeda (*Chem. News*, 1904, **89**, 305) have published an open letter upon the subject,* and, in response to a demand within the German Chemical Society, the committee representing that body issued a circular to the members of the larger International Committee, asking for an expression of opinion as to our procedure. We are not yet informed regarding the responses to that circular, and we therefore cannot base any action upon it. The Council of the American Chemical Society has also, by a formal vote, requested this committee to ask for instructions from the larger body, both as to the use of a double standard and as to the nomenclature and symbols of glucinum or beryllium, and columbium or niobium. With this request we now comply, and hope that every member of the larger International Committee on Atomic Weights will send in his opinion upon the questions thus raised. Shall we continue to issue a double table? Can uniformity in symbols and nomenclature be obtained? And which names are preferable, in the light of history, evidence, and international usage, for the two elements under discussion?

That a single standard for atomic weights is most desirable, every chemist will admit, but two standards actually exist, and each one is represented by earnest advocates who are unwilling to give way. Each side of the controversy is supported by eminent authorities in nearly equal numbers, and no agreement seems to be possible either at present or within the near future. This condition of affairs the present committee has been compelled to face, and to deal with things as they are instead of as we should like them to be. Two tables of atomic weights exist, and it has therefore seemed wisest to recognise the needs of both parties in the controversy, and to furnish each with trustworthy data for practical use. It is surely better to have one committee prepare both tables, than to leave this work to be done in accordance with individual preferences. That there are difficulties in adjusting one table to the other is perfectly evident; but the resulting confusion is, we think, less serious than some of our critics would have us believe. The confusion is certainly less than it would be were the individual advocates of either standard to attempt the adjustment of one to the other independently. In short, the real question now before us seems to be this: Shall the present committee act in a quasi-judicial manner, recognising both parties in controversy, or shall it assume a partisan position and represent one alone?

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* See reply by F. W. Clarke in *Chem. News*, **90**, 56, July 29, 1904.

F. W. CLARKE.
HENRI MOISSAN.
KARL SEUBERT.
T. E. THORPE.

International Atomic Weights.

		O=16.	H=1.			O=16.	H=1.
Aluminium	Al	27·1	26·9	Neodymium	Nd	143·6	142·5
Antimony	Sb	120·2	119·3	Neon	Ne	20	19·9
Argon	A	39·9	39·6	Nickel	Ni	58·7	58·3
Arsenic	As	75·0	74·4	Nitrogen	N	14·04	13·93
Barium	Ba	137·4	136·4	Osmium	Os	191	189·6
Bismuth	Bi	208·5	206·9	Oxygen	O	16·00	15·88
Boron	B	11	10·9	Palladium	Pd	106·5	105·7
Bromine	Br	79·96	79·36	Phosphorus	P	31·0	30·77
Cadmium	Cd	112·4	111·6	Platinum	Pt	194·8	193·3
Cæsium	Cs	132·9	131·9	Potassium	K	39·15	38·85
Calcium	Ca	40·1	39·7	Praseodymium	Pr	140·5	139·4
Carbon	C	12·00	11·91	Radium	Rd	225	223·3
Cerium	Ce	140·25	139·2	Rhodium	Rh	103·0	102·2
Chlorine	Cl	35·45	35·18	Rubidium	Rb	85·5	84·9
Chromium	Cr	52·1	51·7	Ruthenium	Ru	101·7	100·9
Cobalt	Co	59·0	58·55	Samarium	Sm	150·3	149·2
Columbium	Cb	94	93·3	Scandium	Sc	44·1	43·8
Copper	Cu	63·6	63·1	Selenium	Se	79·2	78·6
Erbium	Er	166	164·7	Silicon	Si	28·4	28·2
Fluorine	F	19	18·9	Silver	Ag	107·93	107·11
Gadolinium	Gd	156	154·8	Sodium	Na	23·05	22·88
Gallium	Ga	70	69·5	Strontium	Sr	87·6	86·94
Germanium	Ge	72·5	72	Sulphur	S	32·06	31·82
Glucinum	Gl	9·1	9·03	Tantalum	Ta	183	181·6
Gold	Au	197·2	195·7	Tellurium	Te	127·6	126·6
Helium	He	4	4	Terbium	Tb	160	158·8
Hydrogen	H	1·008	1·000	Thallium	Tl	204·1	202·6
Indium	In	115	114·1	Thorium	Th	232·5	230·8
Iodine	I	126·97	126·01	Thulium	Tm	171	169·7
Iridium	Ir	193·0	191·5	Tin	Sn	119·0	118·1
Iron	Fe	55·9	55·5	Titanium	Ti	48·1	47·7
Krypton	Kr	81·8	81·2	Tungsten	W	184	182·6
Lanthanum	La	138·9	137·9	Uranium	U	238·5	236·7
Lead	Pb	206·9	205·35	Vanadium	V	51·2	50·8
Lithium	Li	7·03	6·98	Xenon	Xe	128	127
Magnesium	Mg	24·36	24·18	Ytterbium	Yb	173·0	171·7
Manganese	Mn	55·0	54·6	Yttrium	Yt	89·0	88·3
Mercury	Hg	200·0	198·5	Zinc	Zn	65·4	64·9
Molybdenum	Mo	96·0	95·3	Zirconium	Zr	90·6	89·9

Of the following papers, those marked * were read :—

*1. "Nitrogen halogen derivatives of the sulphonamides." By Frederick Daniel Chattaway.

The nitrogen halogen derivatives of the sulphonamides, which are obtained by the action of hypochlorous acid on the sulphonamides and the alkylsulphonamides, are remarkable for the great ease with which they can be prepared and crystallised, and for their comparative stability. The sulphondichloroamides all react with alkali hydroxides, forming the corresponding hypochlorite and the salts of the sulphonmonochloroamides. The latter salts, which are well crystallised and frequently contain water of crystallisation, only slowly undergo further hydrolysis. They have, in all probability, the *iso*-structure.

The sulphondichloroamides, alkali sulphonmonochloroamides, and sulphonalkylchloroamides easily enter into all the reactions characteristic of nitrogen chlorides, and illustrate exceptionally well the behaviour of the nitrogen halogen linking, as the various types of simple interaction may with these substances be studied uncomplicated by the transformations which so readily occur with unsubstituted acylphenylchloroamides.

Sulphondibromoamides and sulphonalkylbromoamides are obtained most easily by a method analogous to that by which the corresponding sulphonchloroamides are prepared; that is, by the action of hypobromous acid on the corresponding amides (compare Hoogewerff and van Dorp, *Rec. Trav. Chim.*, 1887, **6**, 373 ; 1889, **8**, 173). They resemble the chloroamides in many of their properties, but are not so stable, and have a bright yellow or orange colour. The dibromoamides, which crystallise well and can be kept for some days unchanged, slowly decompose on longer keeping, bromine being generally liberated. When warmed with solutions of alkali hydroxides, they form salts, one bromine atom being replaced by metal. These salts are beautifully crystalline, pale yellow substances frequently containing water of crystallisation, which is lost at 100° ; when more strongly heated, they decompose explosively. As in the salts of the chloroamides, the metal is probably attached to oxygen.

A large number of typical examples of these compounds were described.

*2. "Electrolytic oxidation of the aliphatic aldehydes." By Herbert Drake Law.

The chief product of oxidation of the lower members of the saturated aliphatic aldehydes is the corresponding organic acid. To a smaller extent, the oxidation proceeds further, carbon dioxide and carbon monoxide being formed, and in the cases of acetaldehyde and propaldehyde small quantities of saturated hydrocarbons are also produced: $RCOH + O = RH + CO_2$. No corresponding reaction takes place in the cases of formaldehyde and *iso*butaldehyde.

In these experiments, sulphuric acid was used as electrolyte. The gaseous products were collected in Hofmann's electrolytic apparatus fitted with platinum electrodes. The amount of acid formed was estimated in a porous pot fitted with a rotating platinum stirrer.

DISCUSSION.

Dr. F. M. PERKIN said that one of the most interesting points brought out in the paper was the formation of small quantities of hydrocarbons in an oxidation process. It was remarkable how extremely stable the aldehydes were to electrolytic oxidation. This was shown most strikingly in the case of the aromatic aldehydes. Thus, if a mixture of toluene and benzaldehyde was subjected to electrolytic oxidation, the hydrocarbon was oxidised in preference to the aldehyde (*Trans. Faraday Soc.*, 1904, 31). Some of the oxidations were best explained by supposing that the hydroxyl group and not free oxygen took part in the reaction, as, for example, in the formation of methyl alcohol in the electrolytic oxidation of an alkali acetate (*Annalen*, 1902, **323**, 304).

*3. "The diazo-derivatives of the benzenesulphonylphenylenediamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

Benzenesulphonyl-p-*phenylenediamine*, $PhSO_2\cdot NH\cdot C_6H_4\cdot NH_2$ (m. p. 173°), when diazotised in hydrochloric acid, yields a stable, colourless *diazonium chloride*, $PhSO_2\cdot NH\cdot C_6H_4\cdot N_2Cl$, which, on treatment with aqueous alkalis or sodium acetate, condenses to form a yellow *diazoimide*, $C_6H_4{:}[N_3]\cdot SO_2Ph$ (m. p. 155°), this substance being produced directly when the base and nitrous acid interact in glacial acetic acid.

The corresponding ortho-compound (m. p. 165—167°), when treated with nitrous acid either in hydrochloric or glacial acetic acid solution, at once gives rise to a colourless cyclic *diazoimide* (m. p. 130°); in this case, the intermediate diazonium salt could not be isolated.

When the iminic hydrogen atom of the $PhSO_2\cdot NH$ group in the foregoing bases is replaced by methyl, the resulting compounds, *benzenesulphonylmethyl*-p-(and -o-)-*phenylenediamines*, yield diazonium salts, $PhSO_2\cdot NMe\cdot C_6H_4\cdot N_2Cl$, which do not condense to form diazoimides;

these products were characterised by the formation of their azo-β-naphthol derivatives.

Benzenesulphonyl-m-*phenylenediamine* (m. p. 98—99°) differs greatly from its ortho- and para-isomerides in its behaviour towards nitrous acid; in hydrochloric acid, it yields a diazonium chloride which, when freed from excess of acid or when treated with aqueous sodium acetate, evolves nitrogen and becomes converted into an azo-derivative approximating in composition to the formula

$$PhSO_2{\cdot}NH{\cdot}C_6H_4{\cdot}N_2{\cdot}C_6H_3(OH){\cdot}NH{\cdot}SO_2Ph.$$

This change no longer occurs when the iminic hydrogen is replaced by methyl, and as-*benzenesulphonylmethyl*-m-*phenylenediamine* (m. p. 96°), like its ortho- and para-isomerides, yields successively a normal diazonium salt and an azo-β-naphthol derivative (m. p. 129—131°).

DISCUSSION.

Dr. CAIN mentioned that he had diazotised large quantities of *p*-aminoacetanilide in the manufacture of Coomassie Black, but had not noticed the formation of substances analogous to those described by the authors. Their failure to diazotise an amino-group in the ortho-position to a mono-substituted amino-group was in accordance with the work of other investigators on such compounds.

Dr. HEWITT agreed with Dr. Morgan respecting the probably essential difference in structure of the compounds obtained by the action of nitrous acid on the monobenzenesulphonyl derivatives of *o*- and *p*-phenylenediamines. Of the two cyclic formulæ proposed for the ortho-compound, that in which a quinquevalent nitrogen atom was assumed seemed, however, very improbable; nitrogen, as far as we know, only becoming quinquevalent in the case of salt formation.

Dr. MORGAN, in reply, said that as benzenesulphonyl-*p*-phenylenediamine had been found to yield a new type of diazoimide, it became of interest to ascertain the behaviour of the similarly substituted ortho- and meta-diamines under comparable conditions.

With reference to the alternative diazonium formula for the ortho-diazoimide, it seemed necessary to consider this possible configuration, inasmuch as, on account of the distinctly acidic nature of the complex $C_6H_5{\cdot}SO_2{\cdot}NH$, the condensation of this substituent with the adjacent basic diazonium group might be regarded as involving the formation of an internal salt.

*4. "The molecular condition in solution of ferrous potassium oxalate." By Samuel Edward Sheppard and Charles Edward Kenneth Mees.

Ferrous oxalate dissolves in alkali oxalates, forming double salts, such as $K_2Fe(C_2O_4)_2$, which dissociate according to the scheme

$$2\overset{+}{K} + \overline{Fe}(C_2\overline{O}_4)_2.$$

The complex anion, $\overline{Fe}(C_2\overline{O}_4)_2$, is not very stable, and by solubility determinations the value 0·8 was found for the constant

$$K = \frac{C_{\overline{Fe}(C_2\overline{O}_4)_2}}{C_{\overline{C}_2\overline{O}_4}}$$

at 20°.

Spectrophotometric measurements showed that the formation of ferrous ions at moderate dilutions was negligibly small.

The action of acids is to precipitate ferrous oxalate by removing free oxalate ions, thus disturbing the equilibrium indicated above.

The absorption-spectrum was measured at three concentrations. The absorption is unilateral, increasing uniformly toward the violet end of the spectrum.

*5. "A further analogy between the asymmetric nitrogen and carbon atoms." By Humphrey Owen Jones.

In the present state of our knowledge of the stereoisomerism of quinquevalent nitrogen compounds, any definite knowledge about the similarity and difference between them and asymmetric carbon compounds is of value. The author has proved that, during the formation of an asymmetric nitrogen atom in a compound containing an asymmetric carbon atom, two isomerides, which are called the α- and β-compounds, are produced. Methyl-*l*-amylaniline has been combined with allyl and benzyl iodides.

The dextrorotatory α-allyl compound can be isolated by crystallisation from alcohol; $[\alpha]_D$ in chloroform $= 21·8°$, gradually falling to 3·1° as the α-isomeride changes into the β-derivative until equilibrium is attained.

The two benzyl compounds cannot be separated in the same way, because the difference in solubility is not great, and they are very labile. They have therefore been separated by means of their camphorsulphonates. α-Phenylbenzylmethyl-*l*-amylammonium iodide melts at 144—145° and has $[\alpha]_D$ in chloroform $= 65°$; the β-compound melts at 131—132° and has $[\alpha]_D = -18·8°$.

The chloroform solutions of both compounds change rapidly until equilibrium is attained with $[\alpha]_D = 2·8°$.

6. "The formation of magnesia from magnesium carbonate by heat and the effect of temperature on the properties of the product." By William Carrick Anderson.

Magnesia prepared from different substances and by different methods is known to vary greatly in properties, and it is generally supposed that this is due either to variation in the size of the molecule of the oxide, or to a difference in the grouping of the magnesium and oxygen atoms in the molecule, or to both of these causes. In the absence of a method of determining the molecular weights of solid substances, evidence in support of the view that the magnesia is polymerised must be indirect.

Experiments were conducted on the native magnesium carbonate (magnesite) and on three forms of artificial carbonate with the view of ascertaining (1) the lowest temperature at which the evolution of carbon dioxide could be distinctly recognised; (2) the comparative rates at which the expulsion of the gas takes place at higher temperatures under atmospheric pressure; and (3) the extent to which the samples of magnesia thus obtained dissolve in water after being kept at different known temperatures for a fixed period. This solubility was determined after leaving an excess of the specimen in water for 2 hours at 20°.

In 20 hours at 350°, native magnesite yielded a quantity of carbon dioxide equal to 0·40 per cent. of its weight, and the rate of evolution increased rapidly with rise of temperature. Complete expulsion was reached at about 750° with two at least of the artificial carbonates, but only above 810° in the case of the third ("heavy carbonate").

The rate of solution of the magnesia obtained by heating the "heavy carbonate" was found to be greater than that of the samples obtained from "light" and "crystal" carbonate under the same conditions, so long as the heating was little more than that needed for complete decomposition of the carbonates. As the temperatures of preparation were increased, the rate of solution diminished in every instance, but much more rapidly in the case of the "heavy" oxide than in those of the other two.

It is inferred from these results that polymerisation takes place when magnesia is heated, and that this goes on faster in the dense "heavy" oxide than in the lighter specimens of magnesia. The rate of solution as determined in the experiments is believed to be a measure of the rate of hydration, and this appears to be most rapid in the molecule $(MgO)_n$ obtained by heating the heavy carbonate at 810°.

7. "Transformations of derivatives of *s*-tribromodiazobenzene."

By Kennedy Joseph Previté Orton.

The discrepancy between the results obtained by the author (*Proc. Roy. Soc.*, 1902, **71**, 153; Trans., 1903, **83**, 796) and by Hantzsch (Hantzsch and Pohl, *Ber.*, 1902, **35**, 2964; and Hantzsch, *Ber.*, 1903, **36**, 2069) with respect to the transformations of *s*-tribromobenzenediazonium salts and *s*-tribromobenzenediazotates has led the author to reinvestigate these reactions.

According to the author, in solutions of the diazonium salts of weak acids, that is, solutions in which the ions $(C_6H_2Br_3{\cdot}N_2)^{\cdot}$ and $(OH)'$ are simultaneously present, a replacement of a bromine atom by hydroxyl takes place, bromine ions appearing in the solution, and 3:5-dibromo-*o*-benzoquinonediazide (3:5-dibromodiazophenol), $O{\vdots}C_6H_2Br_2{\vdots}N_2$, being formed. A similar decomposition takes place when a solution of the corresponding *s*-tribromobenzenediazotate is treated with quantities of an acid insufficient to convert the diazo-compound into the diazonium salt, the free diazohydroxide, $C_6H_2Br_3{\cdot}N{\vdots}N{\cdot}OH$, thus formed, probably now cleaving into the groups $(C_6H_2Br_3{\cdot}N_2)^{\cdot}$ and $(OH)'$.

According to Hantzsch, on the other hand, under both conditions the primary product of the change is *s*-tribromophenylnitrosoamine, $C_6H_2Br_3{\cdot}NH{\cdot}NO$, a substance which, although at first thought to be readily capable of isolation (*Ber.*, 1902, **35**, 2964), is now stated (*Ber.*, 1903, **36**, 2069) to be unstable and, at any but low temperatures, liable to decompose into the quinonediazide with the elimination of hydrogen bromide.

The difference between these two results is ascribed by Hantzsch to the fact that the author carried out his experiments at the ordinary temperature and not at as low a temperature as possible.

In the new experiments, the solutions have been kept partially frozen during the reaction, and the primary product has been examined in order to ascertain if any decomposition, which was accompanied by the formation of quinonediazide and the elimination of hydrogen bromide, could be detected. The author's earlier observations, namely, that the primary product was a mixture of a complex condensation product with the quinonediazide, were completely confirmed.

The proportion of the quinonediazide in the primary yellow product was estimated by conversion into the azo-β-naphthol derivative, and found to represent about 12 per cent. of the diazonium hydrogen sulphate, when 2 gram-mols. of hydrogen carbonate were used for each gram-mol. of diazonium salt; at the same time, it was shown that the quinonediazide did not arise during the operation from the decomposition of *s*-tribromophenylnitrosoamine, as no simultaneous formation of hydrogen bromide could be detected.

In the yellow aqueous extract of the primary product, which, according to Hantzsch, contains the nitrosoamine in solution, the author was unable to find any substance but the quinonediazide. On keeping or on heating, no decomposition accompanied by the elimination of hydrogen bromide was observed; the diazophenol could be completely extracted from the solution by chloroform and then coupled with alcoholic β-naphthol; lastly, when exposed to light, the solution behaved in the manner characteristic of diazophenols.

Experiments showed that between the limits of 0° and 15° temperature has but little effect on the extent of the decomposition of the *s*-tribromodiazobenzene; as the author has previously stated, the prime factors appear to be the concentrations of the ions $(C_6H_2Br_3 \cdot N_2)^{\cdot}$ and $(OH)'$.

The author sees, therefore, no reason for modifying the views expressed by him in former papers as to the mechanism of this reaction, and thinks that at present there is not sufficient evidence for supposing that a nitrosoamine is the primary product, which subsequently decomposes into quinonediazide and hydrogen bromide.

8. "The addition of sodium hydrogen sulphite to ketonic compounds." By Alfred Walter Stewart.

The statement made by Beilstein in his *Handbuch* (3rd ed., I, 999), that pinacoline forms no addition product with sodium hydrogen sulphite, when taken in conjunction with the current idea that "bisulphite" compounds are formed only with those ketones which contain the acetyl group, suggests that the introduction of methyl groups into the ketonic chain has a tendency to prevent the formation of an additive product. With the view of testing the correctness of this idea, and in order to estimate the relative amounts of the double compounds formed with different ketones, advantage was taken of the fact that iodine solution does not oxidise the SO_3Na group of a ketonic bisulphite compound. Thus, if two solutions, one of pure sodium hydrogen sulphite and the other containing a mixture of this salt and a ketonic compound, are titrated, the difference in the number obtained on titration indicates the amount of additive product formed. This method was applied to several compounds containing the acetyl group and the principal results are shown in the following table:

	Percentage of bisulphite compound formed in			
	10 minutes.	30 minutes.	50 minutes.	70 minutes.
Acetaldehyde	85·0	88·0	88·7	88·7
Acetone	28·5	47·0	55·9	58 9
Methyl ethyl ketone	14·5	25·1	32·4	38·4
Methyl propyl ketone.........	8·5	14·8	19·6	25·5
Methyl *iso*propyl ketone......	4·2	7·5	11·6	13·0
Pinacoline	4·2	5·6	5·6	5·6

9. "The reduction products of anisic acid." By John Scott Lumsden.

When anisic acid dissolved in amyl alcohol is reduced by sodium, the products of reduction are hexahydrobenzoic acid and δ-ketohexahydrobenzoic acid. The formation of the former acid is explained by the removal of the methoxy-group of anisic acid and the complete hydrogenation of the ring, but the production of the δ-ketonic acid is more difficult to understand, being probably due to four hydrogen atoms becoming attached, and then, by the agency of one molecule of water, the methyl group is removed as methyl alcohol, and the hydrogen of the water is added to the γ-carbon atom. By analysis of the ketonic acid and its salts and from the melting point of the semicarbazone, it is proved to be identical with the acid recently prepared synthetically by Perkin (Trans., 1904, **85**, 416).

10. "The physical properties of heptoic, hexahydrobenzoic, and benzoic acids and their derivatives." By John Scott Lumsden.

From hexahydrobenzoic acid, which was obtained pure from anisic acid, the methyl, ethyl, and propyl esters, the acid chloride and anhydride, and the amide and anilide were prepared and their properties compared with the corresponding compounds of heptoic and benzoic acids. It was found that the properties of hexahydrobenzoic acid and its derivatives were in general intermediate between those of the other two acids, the melting points, boiling points, specific gravities, and refractive indices being higher than those of the heptoic, and lower than those of the benzoic acid series.

The solubilities of the three acids are nearly alike, but the affinity constant of the hexahydro-acid is lower than that of benzoic acid, and is like the value of that of an acid of the fatty series. The boiling points of the hexahydro-compounds are regularly 9° higher than the heptoic, and 15° lower than the corresponding benzoic derivatives. A comparison of the molecular volumes showed that a hexamethylene ring and a benzene nucleus have identical volumes, while measurements with a Pulfrich's refractometer proved that the hexamethylene structure has no influence on the refraction of light, but that a benzene nucleus retards light to an amount equal to that due to six hydrogen atoms, thus making the molecular refractions of the corresponding derivatives of benzoic and hexahydrobenzoic acid identical.

11. "The influence of solvents on the rotation of optically active compounds. Part VII. Solution-volume and rotation of menthol and menthyl tartrates." By Thomas Stewart Patterson and Francis Taylor.

The authors have examined the rotation of menthol, *l*-menthyl *d*-tartrate, and *l*-menthyl diacetyl-*d*-tartrate in ethyl alcohol, benzene, and nitrobenzene, and have compared the values obtained with the corresponding values for molecular-solution-volume. The results were considered, on the whole, to confirm the suggestion that rotation in solution and molecular-solution-volume are closely related phenomena. For menthol, the facts are in complete agreement with theory. With menthyl tartrate, the results for alcohol and nitrobenzene are in good agreement, although the relationship between the two variables in benzene is anomalous. Difficulties are met with also for menthyl diacetyltartrate; but although in alcohol and benzene the relationship is not a quantitative one, it is in accordance with theory in so far as, in both cases, contraction brings about increased rotation. Out of the nine examples studied, seven are in agreement with the relationship suggested.

ALTERATION OF LIBRARY RULE 4.

Instead of :—

> "New Books are not available for circulation till two months after their names have appeared in the Proceedings."

The Rule now reads :—

> "A Book may not be taken out of the Library until one month after it has been received."

ADDITIONS TO THE LIBRARY.

I. Donations.

Internationaler Kongress für angewandte Chemie (V). Berlin, Juni 1903. Bericht erstattet vom Präsidenten des Kongresses Otto N. Witt, und dem wissenschaftlichen Sekretär des Kongresses Georg

Pulvermacher. 4 Bände. pp. xii + 795, xii + 1021, xii + 1075, xv + 1156. ill. Berlin 1904. (*Recd.* 7/1/05.) From the Congress.

Wardle, Sir Thomas. Kashmir: its new silk industry, with some account of its natural history, geology, sport, etc. pp. xx + 363. ill. London 1904. (*Recd.* 12/1/05.) From the Author.

II. By Purchase.

Bunsen, Robert. Gesammelte Abhandlungen. Im Auftrage der Deutschen Bunsen-Gesellschaft für angewandte physikalische Chemie, herausgegeben von Wilhelm Ostwald und Max Bodenstein. 3 Bände. pp. cxxvi + 536, 660, 637. ill. Leipzig 1904. (*Recd.* 14/12/04.)

Gay-Lussac, Louis Joseph. Untersuchungen über das Jod. (1814). Herausgegeben von Wilhelm Ostwald. (Ostwald's *Klassiker*, No. 4.) Leipzig 1889. (*Recd.* 29/12/04.)

Kayser, H. Handbuch der Spectroscopie. 2 Bände. pp. xxiv + 781, xi + 696. ill. Leipzig 1900—1902. (*Recd.* 21/12/04.)

At the next Ordinary Meeting, on **Thursday**, February **2nd**, 1905, at **8** p.m., the following paper will be communicated:—

"Studies in the camphane series. Part XVI. Camphorylcarbimide and isomeric camphorylcarbamides." By M. O. Forster and H. E. Fierz.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

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Wednesday, January 25th, 1905. Extra meeting. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Professor W. H. Perkin, F.R.S., delivered the Wislicenus Memorial Lecture.

Professor Percy Frankland, in proposing a vote of thanks, said :

" As a pupil of the late Professor Wislicenus, it has afforded me the greatest pleasure to listen to the admirable discourse of my friend Professor Perkin on the life-work of the great master to whom both he and I look back with reverence and affection, and to whom we both, and indeed all his pupils, of whom there are several others in the room to-night, owe so much and in such a variety of ways.

As one who, perhaps more than any of his other English students, enjoyed the privilege of his personal friendship and confidence, connected as I was with him by family ties, I may perhaps be permitted to add a few words with regard to Wislicenus as a man.

His work and reputation as an investigator will last as long as the present era of civilisation continues, for in the classical publications of which he is the author he has built up for himself a monument more enduring than brass or marble ; but there is risk that the knowledge of many of the rare gifts with which he was so liberally endowed may pass away with the generation that knew him. The commanding presence and those regular features, which might have well served Phidias or Praxiteles as a model for the Olympian Zeus, can, and will, be handed down in the portraits of him which are extant, but not so that magnetic oratory which clothed with romantic charm even the driest details of our science, nor the sympathetic flash of his penetrating eye and the kindly geniality of his smile, for these are things which can live only in the memories of those who had the privilege of his acquaintance in the flesh.

All through life Wislicenus was destined to be a leader of men. Already at school, as you have heard, he excelled all other boys in physical exercises—in swimming and gymnastics, in natural science, and especially in his command of the German language. When trouble came upon his father's house, you have heard how the conduct of his family into exile in America devolved upon him, although he was but eighteen years of age at the time. On the way to America, when cholera broke out on the ship, we find him taking charge of the steerage passengers stricken with the disease, and who had been abandoned by the doctor, not because the latter was overwhelmed with the necessities of the saloon passengers, as charitably asserted by Professor Perkin, but in reality because the doctor was devoting his attention to the whisky bottle in his own cabin. Arrived in America we find him supporting the family out of his slender earnings when he was still in his apprenticeship. On his return to Europe we find him rapidly promoted to the highest position in the academic world of Switzerland. At Würzburg he twice occupied the honourable position of Rector Magnificus of the University, and on the second occasion he was specially selected as, of all the professors, obviously the one most fitted to preside over the festivities connected with the tercentenary Jubilee of the University. On his transference to Leipzig we find him again soon filling the office of Rector of that University.

But it was not only in academic matters that he was marked out for leadership and distinction, for in any emergency, whether in private or public life, his friends and colleagues turned to him for support and counsel. This is well illustrated by an incident which occurred in Zürich at the close of the Franco-German war. The German inhabitants were celebrating the declaration of peace by means of a 'Commers' in the Tonhalle, and had thereby so excited the hostility of the Swiss, who were violently pro-French in their sympathies, that an angry crowd gathered outside, commenced throwing stones, and ultimately, I regret to say at the instigation of an English student, set fire to the building. The situation inside had now become very serious, the staircase was in flames and no water was procurable. Under these circumstances Wislicenus, who was presiding over the assembly, conceived the idea as original as it was effective of having a cask of beer brought up from the cellar, and, after placing it in a suitable position, ordered it to be broken to pieces, with the result that the escaping beer extinguished the fire. When the company then left the building with Wislicenus at their head, his majestic figure, suggestive of a mediæval knight '*sans peur et sans reproche*,' silenced the hooting multitude, which until his appearance in their midst had been quite prepared to stone the Germans, and even to burn them alive.

In politics Wislicenus was also a great power, especially in the later years of his life. He was one of the founders of the 'Alldeutscher Verband' or Pan-Germanic Confederation, and he was the originator of the idea of greatly increasing the strength of the German Navy.

If I am not trespassing too much on your time I should like to relate a story told me by Wislicenus about one of his experiences in America, and which throws an interesting light on the state of professional chemistry in that country during the 'fifties of the last century. One day he was visited in his laboratory by two American gentlemen, who requested him to analyse and report on a sample of water from a mineral spring which they wished to boom for its therapeutic properties. They said they must have the analysis and report by the afternoon of the same day. This, Wislicenus said, was quite impossible, as the analysis would certainly take several days, and possibly even longer. The gentlemen replied that they were of course prepared to pay him double the usual fee, provided that the results of analysis were in their hands by the afternoon. Their surprise was unbounded when he still remained obdurate, and, saying that they guessed he must be a young greenhorn, they went to another chemist of high repute in the city, who duly furnished them with an elaborate analysis and report on the same day. This chemist afterwards cynically told Wislicenus that he had, to meet the exigency of the case, devised a method of analysing water by smell! In this atmosphere, Wislicenus began to feel exercised as to his moral security, or, to use his own words, '*ich fühlte mich dort nicht gewahr*,' and resolved to return to Europe at the earliest possible opportunity.

But Wislicenus exhibited the same high principle in all his dealings, and carried his lofty idealism and undivided devotion to duty into the smallest details of life, and these aspirations he had the power of communicating to those with whom he came in contact. Without any touch of Puritanism in the ordinary sense of the word, for he was full of good-fellowship and the friend of conviviality, he was one of those men who purify all their surroundings. In his presence it was impossible for anyone to harbour a mean or unworthy thought; his searching but optimistic gaze irresistibly drew forth the good and cast out the evil. It was also by means of this unquenchable optimism, let us call it Faith, *der unerschütterliche Glaube*, that he was able to bear with such marvellous fortitude and resignation the terrible domestic afflictions with which his home was repeatedly visited, and which were calculated to embitter or even drive to despair any weaker nature, but which served to impress the spectator of Wislicenus's troubles with awe and reverence for the absolute fearlessness and self-command of the man. Indeed, I have always felt that to him might well be applied the lines of Horace descriptive of the unswerving heroism of the stoic:

> 'Si fractus illabatur orbis;
> Impavidum ferient ruinæ.'"

Professor **Armstrong** seconded the motion, which was supported by Dr. L. T. **Thorne**, who said:

"As another old pupil of Professor Wislicenus, I wish warmly to support the vote of thanks proposed to Professor Perkin for the admirable memorial lecture he has just given, and also to add my own word of homage and gratitude to the memory of our old and loved master. I had the privilege not only of being one of Wislicenus's pupils, but also of being for some time his lecture assistant, and, as such, of living under the same roof with him, and therefore of seeing much of his family life. I can fully confirm the vivid picture of the strong, noble, and kindly nature of the man which has been given by the lecturer. Wislicenus knew, and was interested in, the work of all his students, even the most elementary. To his advanced students engaged in research work he was not only the teacher, but also the friend and fellow-worker in his beloved science, and his own love for and enthusiasm in chemical research roused a similar feeling in his pupils. At the meetings of the Würzburg Chemical Society, which he founded, he was not so much the master as the fellow-student, and these meetings were most helpful, and are still a pleasant memory with all old pupils.

All will read with the greatest interest the review of Wislicenus's work given by the lecturer, work which has been of such value to chemistry in general, and to the question of the atomic configuration in space in particular. Although, as Professor Perkin has said, not many papers dealing directly with this latter subject appeared during Wislicenus's professorship at Würzburg, I can testify that the interest in this question largely underlay the work of Wislicenus and his pupils during that period. Much of the work on the derivatives of ethyl acetoacetate was undertaken in the hope that, by modifying the conditions of replacement, substances showing optical activity might be artificially built up, and thus help to prove the asymmetrical theory ; and although negative results always ensued, Wislicenus's interest in the question did not diminish.

Personally I have always felt that Wislicenus's strong personality and friendly and even fatherly interest had a great influence on my life, an influence which I acknowledge with gratitude, and I believe the same feeling is entertained by all other old pupils. Wislicenus's life and work has undoubtedly done much for the good of chemistry."

The vote of thanks to the lecturer was then carried unanimously.

Thursday, February 2nd, 1905. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

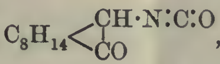
Messrs. Percy E. Spielmann and Alfred F. Joseph were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Bernard Scott Evans, B.Sc., 81, Babington Road, Streatham, S.W.
John Greig Ferrier, 2, Dalhousie Place, Arbroath, N.B.
Archibald Melville Glass, B.Sc., 73, Roderick Road, Hampstead, N.W.
Samuel Ernest Groves, 10, Melrose Avenue, Monkseaton.
Peter Maguire, Hamer House, Rochdale, Lancs.
Ernest Robert Marle, B.Sc., 135, Le Marchant Road, St. John's, Newfoundland.
Charles Stuart Shepherd, Worth Matravers Vicarage, Wareham.
William Ewart Speight, Corporation Sewage Works, Deighton, Huddersfield.
Arthur Walsh Titherley, D.Sc., Ph.D., Southcot, Moreton, near Birkenhead.

Of the following papers, those marked * were read :—

*12. "Camphorylcarbimide." By Martin Onslow Forster and Hans Eduard Fierz.

Camphorylcarbimide,  $C_8H_{14}\Big<\begin{array}{l}CH\cdot N{:}C{:}O\\ \vert\\ CO\end{array}$, melting at 77°, is readily volatile in steam, and the vapour has a stupefying odour ; it is quickly changed by water to *dicamphorylcarbamide*, $CO(NH\cdot C_{10}H_{15}O)_2$, which melts at 261° and, with organic bases, yields symmetrical disubstituted carbamides, for example, *camphorylpiperidylcarbamide*,

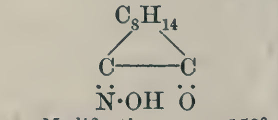
$$CO(NC_5H_{10})\cdot NH\cdot C_{10}H_{15}O,$$

and *camphorylbornylcarbamide*, $CO(NH\cdot C_{10}H_{17})\cdot NH\cdot C_{10}H_{15}O$, which melt at 186° and 305° respectively.

In addition to Rupe's camphorylcarbamide, from which camphorylcarbimide is obtained by the action of nitrous acid, aminocamphor hydrochloride and potassium cyanate yield *camphoryl-ψ-carbamide*, $C_{11}H_{18}O_2N_2$, which melts and decomposes at 188°; the *nitroso*-derivative, $C_{11}H_{17}O_3N_3$, which is not obtainable from the normal compound, melts at 158°, and, when freshly prepared, yields camphorylcarbimide with boiling water, losing this property in the desiccator. *Camphorylmethyl-ψ-carbamide*, $C_{12}H_{22}O_2N_2$, the corresponding substance from methylaminocamphor, melts and decomposes at 200°; it is indifferent towards nitrous acid, and develops an intense, malachite-green colour with concentrated sulphuric acid.

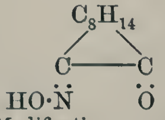
*13. "Configuration of *iso*nitrosocamphor and its unstable modification." By Martin Onslow Forster.

It now seems possible to represent *iso*nitrosocamphor and its unstable form by the configurations

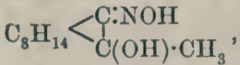


syn-Modification; m.p. 152°.

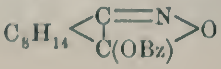
and



anti-Modification; m.p. 114°.

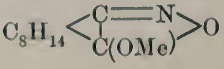
respectively. The evidence which, taken in conjunction with previous observations, has led to this conclusion arises from the behaviour of the isomerides towards magnesium methyl iodide. Of the four *oximes*,  $C_8H_{14}<\begin{matrix}C{:}NOH\\ |\\ C(OH)\cdot CH_3\end{matrix}$, theoretically obtainable, three have been isolated and melt at 178°, 183°, and 187° respectively; these compounds are amphoteric, and solutions of all three in dilute sulphuric acid yield the liquid *anhydride*, $C_{11}H_{17}ON$, when warmed. Only two are transformed in warm alkali, however, the α-oxime (m. p. 178°) resisting this treatment; as the α-oxime is derived from the unstable *iso*nitrosocamphor (m. p. 114°), the latter appears to have the *anti*-configuration.

This conclusion receives support from the behaviour of the colourless benzoyl derivative and the *O*-methyl ether of *iso*nitrosocamphor, which are now represented by the formulæ



$$C_8H_{14}<\begin{matrix}C{=\!=}N\\ |\\ C(OBz)\end{matrix}>O$$

and



$$C_8H_{14}<\begin{matrix}C{=\!=}N\\ |\\ C(OMe)\end{matrix}>O$$

respectively. This type of structure explains the production of α-camphornitrilic acid on hydrolysis and the conversion into α-aminocamphor on reduction; moreover, magnesium methyl iodide transforms the above compounds into dimethylaminocamphor, the yield of which is quantitative in the case of the colourless benzoyl derivative.

*14. "The determination of molecular weight by lowering of vapour-pressure." By Edgar Philip Perman.

The author has worked out the details of a simple method by which molecular weights can be determined with moderate accuracy from measurements of the lowering of vapour-pressure of the solvent in which the substance under investigation is dissolved. The solution is heated in the vapour of the pure solvent, boiling under atmospheric pressure, and the lowering of vapour-pressure is read directly. It is, however, necessary to pay great attention to the manipulation.

DISCUSSION.

Dr. BARGER pointed out that, although the freezing point and the boiling point methods might be considered preferable for ordinary purposes, the value of vapour pressure methods lay in the possibility of applying them to special cases where other methods failed. This was found to be the case with the microscopical vapour pressure method described by him a year ago.

Mr. BALY pointed out that in all probability the determination of molecular weights by the vapour pressure of a solution would be vitiated owing to a difference in the concentration in the surface layer, more than would be the case in observing the boiling point of the solution. In the latter method, a very rapid renewal of surface was taking place, whilst in the former, one is dependent more or less upon a constant surface. He asked whether the author had taken care to shake his apparatus, since differences of concentration in the surface are known to occur, as, for example, in solutions of butyl alcohol.

Mr. ARTHUR MARSHALL said he could corroborate the statements made as to the practicability of ascertaining molecular weights by means of vapour pressure measurements. He described a simple apparatus he had used in determining the vapour tension of binary liquids, in which the difficulty of obtaining a liquid in a uniform condition was overcome by employing a small glass rod placed in such a manner that when the apparatus was shaken the rod stirred the liquid. But even with this precaution he had found that in order to obtain a state of equilibrium it was necessary to allow the apparatus to remain at constant temperature for several hours with occasional shaking.

15. "Note on β-NH-ethenyldiaminonaphthalene." By Raphael Meldola and Joseph Henry Lane.

The ethenyldiaminonaphthalene, obtained by Prager in 1885 by debrominating the bromoanhydro-base prepared by the reduction of 4-bromo-2-nitroaceto-α-naphthalide (*Ber.*, 1885, **18**, 2161), has been assumed in our former paper (*Trans.*, 1904, **85**, 1594, footnote) to be identical with the anhydro-base obtained from Markfeldt's ethenyltriaminonaphthalene by the diazo-method. We have already pointed out (*loc. cit.*) that no direct proof of this identity has hitherto been given, and we have accordingly repeated Prager's experiments with certain modifications, which throw further light on the general nature of the isomerism which has formed the subject of our investigations. The bromonitroaceto-α-naphthalide was reduced with iron and hydrochloric acid instead of with stannous chloride, as in Prager's method, and the bromoanhydro-base was found to be identical with that obtained by the author named. This result is of importance as supporting the hypothesis that the isomerism of the ethenyltriaminonaphthalenes is due to the simultaneous or successive reduction of the nitro-group (*loc. cit.*, p. 1595). When the 4-position is occupied by a bromine atom instead of by a nitro-group, the nature of the reducing agent makes no difference in the nature of the bromoamidine. Iron and tin both give the same product. The latter was debrominated by boiling for 2 days in alcoholic solution with zinc dust and alkali, and the amidine thus obtained was found to be identical in every respect (m. p. of picrate, &c.) with Prager's base. The latter is therefore now conclusively shown to be the β-NH-amidine, as formerly assumed, the transference of the NH-group from the α- to the β-position taking place simultaneously with the removal of the bromine atom in the manner indicated in our last paper (*loc. cit.*, p. 1594).

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Darapsky, L. Enteisenung von Grundwasser. pp. 104. ill. Leipzig 1905. (*Recd.* 23/1/05.) From the Author.

Goppelsroeder, Friedrich. Studien über die Anwendung der Capillaranalyse. pp. 198. ill. Basel 1904. (*Recd.* 23/1/05.) From the Author.

Lassar-Cohn. Chemistry in daily life. Popular lectures. Translated by M. M. Pattison Muir. pp. xii + 340. ill. London 1905. (*Recd.* 18/1/05.) From the Translator.

Lunge, G. Techno-chemical analysis. Authorised translation by Alfred I. Cohn. pp. 136. ill. New York 1905. (*Recd.* 24/1/05.) From the Publishers.

Nobel. Les prix Nobel en 1901. pp. 112. ill. Stockholm 1904. (*Recd.* 14/1/05.) From the Royal Academy of Sciences, Sweden.

II. *By Purchase.*

Claassen, H., und Bartz, W. Die Zuckerfabrikation. pp. x + 270. ill. Leipzig 1905. (*Recd.* 1/2/05.)

Nernst, Walter. Theoretical chemistry from the standpoint of Avogadro's rule and thermodynamics. (Translated by Robert A. Lehfeldt.) Revised in accordance with the fourth German edition. pp. xxiv + 771. ill. 1904. (*Recd.* 18/1/05.)

III. *Pamphlets.*

Alwood, William B., Davidson, R. J., and Moncure, W. A. P. The chemical composition of apples and cider. (U. S. Dept. of Agric., Bureau of Chemistry, Bulletin No. 88.) Washington 1904.

Clayton, Edwy G. The will of Sir William Browne, M.D. (1692—1774). (From the *British Medical Journal*, 1904.)

Lamb, M. Charles. The detection of adulterants in sumach by microscopical examination. (From the *J. Soc. of Dyers and Colourists*, 20, 1904.)

—— The dyeing of chrome leather, and storing in the "crust." (From the *J. Soc. of Dyers and Colourists*, 20, 1904.)

—— "Seaweed as a finishing material for leather." (From the *Leather Trades Review*, 1904.)

—— The determination of sulphuric acid in leather. pp. 7. London 1903.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on **Wednesday, March 29th, 1905**, this being the day fixed for the Annual General Meeting. Further particulars will be announced shortly.

At the next Ordinary Meeting, on **Wednesday**, February **15th**, 1905, at **5.30** p.m., the following papers will be communicated:

"The condensation of phenylglycine esters in presence of sodium ethoxide." By A. T. de Mouilpied.

"Nitrogen halogen derivatives of the aliphatic diamines." By F. D. Chattaway.

"Nitration of substituted azo-phenols." By J. T. Hewitt and H. V. Mitchell.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 15th, 1905.

Angel, Andrea,
41, Wellington Square, Oxford.

M.A. Chemistry Tutor to the Non-Collegiate Students, Oxford University. Late Exhibitioner, and Dixon Scholar of Christ Church, Oxford. First Class Honours (Chemistry) in the Final School of Natural Science, 1899. Joint Author, with Mr. Vernon Harcourt, of "Observations on the Phenomena and Products of the Decomposition of Normal Cupric Acetate when Heated," *J. C. S.* (Trans.), 1902, p. 737. Engaged upon a similar investigation of Cupric Formate.

A. Vernon Harcourt.
D. H. Nagel.
H. Brereton Baker.
W. W. Fisher.
J. E. Marsh.

Arnaud, Francis William Fredk.,
17, Maddox Street, London, W.

Analytical Chemist. Studied Chemistry, etc., at King's College, London. For about ten years have been engaged in Analytical Chemistry, and at present Assistant to C. H. Cribb, Esq., F.I.C. I am an Associate of the Institute of Chemistry.

W. F. Lowe.
Cecil H. Cribb.
A. J. Greenaway.
J. H. Coste.
R. Grimwood.
Frank Clowes.
J. M. Thomson.
E. T. Shelbourn.

Ashwell, James Henry,

117, Waterloo Crescent, Nottingham.

Bleacher and Dyer of Hosiery. Manager of H. Ashwell & Co., Hosiery Finishers. Attended the Chemical Course at Owens College. Member of the Society of Chemical Industry; also of the Faraday Society.

Francis D. Toyne. *A. B. Steven.*
Reginald B. Brown. *A. G. Perkin.*
Arthur Slator. *Henry J. S. Sand.*

Barnes, James Hector,

The Briars, King's Norton, Birmingham.

Analytical Chemist and Assistant to C. C. Duncan, Esq., County Analyst for Worcestershire. Bachelor of Science of the University of Birmingham. Five years Assistant to the late Mr. John Barclay, B.Sc., F.C.S., Analytical Chemist.

Percy F. Frankland. Alex. Findlay.
Alex. McKenzie. T. S. Moore.
T. Slater Price.

Briggs, Samuel Henry Clifford,

Green Bank, Cleckheaton, Yorks.

Worsted Spinner. Student for six years in the University of Leeds. 1st Class Honours in Chemistry in Victoria University B.Sc. exam., 1901. Joint author of following papers: *Trans.*, 1902, 210 (with A. G. Perkin, Esq.); *Proc.*, 1902, **18**, 172, and *Trans.*, 1903, **83**, 1213 (with Prof. J. B. Cohen); Author of following papers: *Trans.*, 1903, **83**, 391; *Trans.*, 1904, **85**, 672 and 677.

Arthur Smithells. J. B. Cohen.
A. G. Perkin. H. M. Dawson.
C. E. Whiteley.

Campbell, James H.,

3, Morrison Terrace, North Road, Bellshill, N.B.

Metallurgical Chemist. For seven years at the Works of the Landore Siemens Steel Co., and for eighteen years chief chemist of the Summerlee and Mossend Iron and Steel Co., Mossend, N.B. At present partner of the firm of Robertson and Campbell, Analytical and Consulting Chemists, Glasgow.

Frederick Robertson. Thomas Gray.
Douglas A. MacCallum. *G. G. Henderson.*
A. Humboldt Sexton.

Clark, F. E.,

Instructor in Chemistry in the Pennsylvania State College, State College, Pa.

Bachelor of Science, West Virginia University, 1898; Doctor of Philosophy, Johns Hopkins University, 1902. Subject of dissertation: "The Action of Substituted Ammonias of the Aliphatic Series on the Chlorides of *ortho*-Sulphobenzoic Acid" (*American Chemical Journal*, vol. 30, p. 277).

Jas. Lewis Howe.
Ira Remsen.
G. G. Pond.
F. P. Venable.
J. F. McGregory.

Clarkson, George Douglas,

Mirfield, Yorkshire.

Analytical Chemist, as applied to Brewing and Malting. For ten years Assistant to Lawrence Briant in general Analytical work and demonstrator in Brewing Chemistry, and five years Analyst to large firm of Maltsters in Yorkshire (present berth).

Alex. K. Miller.
Lawrence Briant.
Tom Crossman.
Arthur J. Starey.
Harold W. Harman.

Collitt, Bernard,

79, Eastbourne Terrace, Gainsborough.

Analytical Chemist to Messrs. Marshall, Sons & Co., Ltd., Engineers, Gainsborough. 1901, Jacob Bell Scholar at the School of Pharmacy; 1902, Passed the Minor Examination; 1903, Passed as Pharmaceutical Chemist and obtained Silver Medal for Chemistry (Advanced), and Certificate for distinguished merit in Botany (Advanced) (of the Pharmaceutical Society of Great Britain). Studied one term in Metallurgical Laboratory of Sheffield University College (Technical Department) under Prof. J. O. Arnold. Spent one year as assistant chemist in the Analytical Laboratory of Messrs. Ludw. Loewe & Co., A.G. Berlin, Germany.

J. Norman Collie.
Arthur W. Crossley.
W. Palmer Wynne.
Harry Lucas.
T. E. Wallis.
F. Filmer De Morgan.
E. J. Millard.
F. M. Mercer.

Eade, Samuel George,

10, Eagle Street, Port Talbot, S. Wales.

Science Master in Port Talbot County School. I have studied Chemistry at Wellingboro' Gram. Sch., University Tutorial Coll., London, Municipal Tech. Sch., Birmingham, and have taught the subject at Loughton School, Essex, and at Port Talbot County School. I have passed the following exams. in Chemistry: Inter. Science and Prelim. Scientific London University. Board of Education, Stage III., Theoretical and Practical (Inorganic).

W. H. Edwards.
Joseph Brown.
George H. West.
J. W. Shepherd.
Wm. Ping.
W. A. Rugginz.

Gardner, Charles Richard,

Green Cottage, Brunswick Sq., Gloucester.

Chief Assistant to Mr. G. Embrey, F.C.S. Student at Gloucester School of Science from 1890 to 1895. As second Assistant to Mr. G. Embrey, F.C.S., F.I.C., Analyst for the County of Gloucester, from 1892 to 1897, and from then until present date as Chief Assistant.

George Embrey.
J. Kear Colwell.
J. S. S. Brame.
Raymond Ross.
Will. T. Boone.

Goodier, Herbert,

16, Hall Royd, Shipley, nr. Bradford.

Experimental Engineer, c/o The Bradford Dyers' Association, Bradford. Experimental Engineer, dealing with new processes, etc., in Dyeing, etc. Holder of 3 years' Scholarship (Evening) in Chemistry and Dyeing, Bradford Technical College. I wish to keep in touch, mainly, with Chemical Literature as applied to Bleaching, Dyeing, Finishing, and Calico-printing.

Thorp Whitaker.
Walter Leach.
John K. S. Dixon.
A. B. Knaggs.
Ellis Clayton.

Heely, Frederick William,

10, Yarborough Street, Grimsby.

Engaged in the analytical work in connection with the Pharmacy of W. Barker, Esq., 81, Victor Street, Grimsby. Passed the Minor and Major Examinations of the Pharmaceutical Society, was for one year a student at the Metropolitan College of Pharmacy, Kennington Park, S.E., and now desirous of having the Society's Publications to keep in touch with modern analytical processes.

W. Watson Will.
F. Filmer De Morgan.
H. Lucas.
David J. Williams.
Edward Divers.
Peter MacEwan.
Thos. Tyrer.

Henderson, James Alexander Russell,

Chihli Provincial College, Paotingfu, N. China.

Professor of Chemistry and Physics. B.Sc. Glasgow University (Ap. 1901): Research with Dr. W. Carrick Anderson on Indian and Japanese Coals: and action of pyridine on coals: published *Jour. Soc. Chem. Ind.*, Feb. 28th, 1902: laboratory assistant and demonstrator to lecturer in Organic Chemistry in Glasgow University, 1899—1901: $3\frac{1}{2}$ years full charge of works laboratory of Messrs. Glenfield & Kennedy, Ltd., Hydraulic Engineers, Kilmarnock. Research on cast-iron and various alloys, especially manganese bronzes. Appointed Prof. of Chemistry.

W. Carrick Anderson. Thomas Gray.
John Ferguson. G. G. Henderson.
James Roberts, jun. *A. Humboldt Sexton.*

Hennings, Dr. Carl Richard,

19, St. Dunstan Hill, London, E.C.

Analytical Chemist. Farbenfabriken vorm. Friedr. Bayer & Co., Elberfeld. German State Examination as Pharmaceutical Chemist, Freiburg i/B. 1899. Ph.D. in Natural Sciences, Freiburg i/B. 1901. German State Examination in Food Chemistry, Berlin, 1902. Contributions: Ber. d. D. Ch. Ges., XXXIV., 1772—1778; XXXV., 1338—1400.

C. Duisberg. Wyndham R. Dunstan.
James Dewar. Thos. A. Henry.
Edgar J. Millard.

Jones, Bernard Mount,

"Alcala," Hermitage Road, Upper Norwood, S.E.

Student of Chemistry, engaged in research work. Natural Science Scholar of Balliol College, Oxford. First Classes in Honours in the Final Schools of Chemistry, Mineralogy, and Crystallography.

H. Brereton Baker. Harold Hartley.
Henry A. Miers. D. H. Nagel.
R. Tabor Lattey.

Jones, Percy Walter,

Toowong, Brisbane, Queensland.

Assistant Government Analyst. Five years Assistant Government Analyst, Queensland. Four years Lecturer in Chemistry for the Pharmaceutical Society and Sydney University Extension Board of Queensland. One year Assistant to Government Analyst, South

Australia. Four years Junior Assistant to Dr. Rennie, Professor of Chemistry, Adelaide University.

J. Brownlie Henderson. W. A. Hargreaves.
J. C. Brünnich. Edward H. Rennie.
Alexander Orr.

Jones, Tudor Foulkes,

Bro Dawel, Bangor, North Wales.

Mathematical and Science Master at Lurgan College, Co. Armagh, Ireland. B.Sc. (Wales). Final Subjects :—Mathematics (Pure and Applied) and Chemistry (Inorganic and Organic); also Intermediate Physics. My training in chemistry extended over 4 years, 1898—1902, and on an average I put in 10 hours a week. I studied at the University College of North Wales, Bangor. Since August, 1902, I have been engaged here as Mathematical and Science Master, the science subjects including Elementary Physics and Elementary and Advanced Chemistry.

James J. Dobbie. J. Holms Pollok.
Alexander Lauder. E. A. Letts.
Robt. D. Abell.

Leech, Herbert Louis,

3, London Road, Blackburn.

Demonstrator in Chemistry at the Technical School, Blackburn. I have studied Chemistry for upwards of six years; for two sessions at the Municipal Technical School, Manchester, at the Victoria University for one year, and have had four years' practical experience in the chemical works of Levinstein's, Ltd., of Crumpsall. I have recently been appointed as assistant to Dr. Pickard and Demonstrator in Chemistry at the Technical School, Blackburn.

Robert H. Pickard. Stanley J. Peachey.
William J. Pope. Frank S. Sinnatt.
L. G. Radcliffe. *Jas. Grant.*

Lister, Joseph,

50, Portland Street, Lancaster.

Science Master. (1) B.Sc., London, with Honours in Chemistry; (2) A.R.C.S., Lond.; "Hatton" prizeman in Chemistry; (3) Lecturer on Chemistry, Leeds Central Higher Grade School, for 5 years. (4) Senior Science Master, Storey Institute, Lancaster, for 1½ years.

William A. Tilden. G. T. Morgan.
M. O. Forster. Chapman Jones.
James C. Philip.

Lloyd, George Moss, M.A., M.Sc.,

"Homeland," Queen's Road, Rock Ferry, Cheshire.

Schoolmaster in employ of Liverpool Education Authority, also a post-graduate student in Chemistry, a Master of Science of the University of Liverpool (degree was taken in 1904 in the Honours School of Chemistry). At present a post-graduate student at the University of Liverpool, doing Chemical Research. Also M.A. (Vict.) and Inter. B.A. (London).

J. Campbell Brown. Sydney Young.
F. G. Donnan. H. B. Dixon.
A. C. Abraham.

Lucas, Edward William, F.I.C.,

37, Barton St., Kensington, W.

Wholesale Chemist and Druggist, late Assistant Government Analyst, Hong Kong. Fellow of the Institute of Chemistry. *Author* of "Practical Pharmacy," pp. 528, "Churchill." Editor of "Beasley's Book of Prescriptions," 1905, Edition "Churchill," and numerous papers on Analytical and Pharmaceutical Chemistry in the Pharm. Journal and other Journals. One of the Referees in Pharmacy in connection with the Revision of the British Pharmacopœia.

W. Palmer Wynne. F. Stanley Kipping.
W. H. Perkin, jun. Percy F. Frankland.
Walter Hills.

Luck, Alfred Courtenay,

Crosslea House, Ipswich.

Explosives Manufacturer, now Chief of the Experimental and Chemical Department for Explosives, Argentina Government. Four years as Assistant to W. E. Halse (late F.C.S., F.I.C.), many years chief chemist to Pigou Mills & Laurence, Ltd., Dartford. Joint author with C. F. Cross of a paper on Nitro-cellulose, read before Chemical Industry Society.

C. F. Cross. Henry de Mosenthal.
Edward Bevan. Oscar Guttmann.
Geo. W. MacDonald.

Meldrum, Andrew Norman,

16, Mooroaks Road, Sheffield.

Lecturer and Demonstrator in Chemistry, University College, Sheffield. Associate of the Royal College of Science, London (1896), Doctor of Science, Aberdeen (1904). Studied Chemistry at Aberdeen University, the Royal College of Science, London, and University

College, Dundee. Lecturer and Demonstrator in Chemistry at University College, Liverpool (1900—2), and Aberdeen University (1902—4). Joint author with Professor Japp of four papers published in the Transactions of the Chemical Society.

F. R. Japp.	W. Palmer Wynne.
James Walker.	W. E. S. Turner.
John S. Lumsden.	M. O. Forster.

Mills, William Sloan, M.A.,
Queen's College, Galway.

Kodak Company's Research Assistant (since 1903), working at Queen's College, Galway. Student and Scholar, Q.C.G., 1894—1900; Dem. of Chem., 1897—1900; B.A. in Chem. and Physics, Hon. and £21 Exhib., 1898; M. A. Honors, 1900; published paper:—"Diphenyl and Dialphyl Ethylene Diamines," etc. (Trans. Chem. Soc., 1900, **77**, 1020); 1851 Exhib. Research Scholar working at Berlin Univ., 1900—1901, 1901—1902 and, for third year, 1902—1903. Other published papers on Glucoside Synthesis and on the Action of Oxides of Nitrogen on Oximido-compounds:—J. Chem. Soc., 1901, Trans., **79**, 704; Scient. Proc. Roy. Dub. Soc., 1901, **9**, 506 and 508; Brit. Assoc. Report, 1903, 635, 636, and 637; Liebig's Annalen, 1904, **330**, 247.

A. Senier.	Alex. McKenzie.
W. Goodwin.	R. H. Aders Plimmer.
E. Frankland Armstrong.	M. O. Forster.

Moore, Charles Watson, B.Sc.,
38, Demesne Road, Whalley Range, Manchester.

Student of Chemistry. Five years a Chemist with Messrs. I. Levinstein & Co., Ltd., and subsequently studied for 4 years at the Owens College. Graduated B.Sc., Victoria University, with First Class Honours in Chemistry in 1904. Author of "The Formation of Phloroglucinol by the Interaction of Ethyl Malonate with its Sodium Derivative" (*Trans.*, 1904, **85**, 165).

H. B. Dixon.	G. H. Bailey.
W. H. Perkin, jun.	William A. Bone.
D. L. Chapman.	J. F. Thorpe.

Pennycuick, Thomas, B.Sc., Lond.,
6, Lorne Street, Fairfield, Liverpool.

Science Master, Green Lane School, Liverpool. B.Sc., London. Assistant Chemistry Master, St. Mark's Upper School, Chelsea

[1895—1898]. First Assistant (Science Master), Green Lane School, Liverpool.

Frank E. Weston.
Henry R. Ellis.
J. Bernard Coleman.
J. C. Crocker.
Edward Haworth.
H. Baker.

Perrott, Bert,

Ael-y-Bryn, Penywern Road, Neath, Glam.

Science Master and Lecturer in Chemistry. As a student I have made a special study of Chemistry for the last 8 or 9 years, having studied at several of the recognised London Institutions, but more especially under Prof. Hewitt at the East London Tech. College. The last 4½ years have been spent in teaching the subject, formerly at the Ilford Higher Grade School and now at the Neath Intermediate and Technical School.

William Ping.
W. A. Rugginz.
J. T. Hewitt.
Thomas L. D. Porter.
J. A. Harrison.

Pyman, Frank Lee,

The Oaks, Hitchin, Herts.

Chemist. 1902, B.Sc. degree (1st Class Chemistry Honours), Owens College, Manchester. Leblanc Medallist, Mercer Scholar, 1904, Ph.D. degree (Basle). Publications: Berichte d. Ch. G., **36**, 2700. Bamberger and Pyman, "Ueber *o*-Hydroxylaminobenzoesäureäthylester." Dissertation (Zurich, 1904), "Ueber *o*-Hydroxylaminobenzoesäure und Oxy-ψ-anthranil."

Harold B. Dixon.
W. H. Perkin, jun.
William A. Bone.
Frederick B. Power.
Frederic H. Lees.

Quant, Ernest,

2, Park Crescent, Torquay.

Analytical and Consulting Chemist, Director of South Devon Chemical and Bacteriological Laboratory. Analyst for last nine years to Devonshire Dairies, Limited, Torquay, and 409, Oxford Street, London. Member of the Pharmaceutical Society. Studied Chemistry (General), School of Science, Gloucester. Pharmaceutical: South London (Muter's) School of Pharmacy. Food Analysis (special courses), Public Analysts' Laboratory, Exeter, and King's College, London.

John Muter.
George Embrey.
John M. Thomson.
Patrick H. Kirkaldy.
Thomas Tickle.
A. H. M. Muter.

Ratcliffe, William Henry,

18, Wheeler Street, Maidstone.

Teacher of Science. B.Sc. (London University). Teacher of Science, Tenison's School, Leicester Square, W.C. I am desirous of keeping in touch with the latest literature in Chemistry.

Frank E. Weston.
H. R. Ellis.
C. T. Bennett.
Edward Haworth.
H. Baker.
Harold M. Read.

Richards, Frederick George,

21, Dutton Street, Manchester.

Demonstrator in the Brewing Department, Municipal School of Technology, Manchester. Three years Student at the School of Technology, 1896 to 1899. Chemist at Oxynite Works, Newport (Mon.), 1899 to 1902. On the staff of the School of Technology from 1902. Honours in Inorganic Chemistry (Science and Art). First Honours and Silver Medallist in Brewing (City and Guilds).

William J. Pope.
Jas. Grant.
L. G. Radcliffe.
F. S. Sinnatt.
Arnold Turner.
Henry Gough.

Rogers, Harold Rudolph,

75, South Side, Clapham Common, London, S.W.

Science Master at the Croydon Borough Secondary School for Boys. (1) Honours, B.A., Oxford, second class in the Final Honour School of Natural Science, Chemical Section. (2) Honours Intermediate, B.Sc., London, in Chemistry. (3) Science tutor at St. Mark's College, Chelsea, S.W.

John Watts.
W. W. Fisher.
J. E. Marsh.
D. H. Nagel.
N. V. Sidgwick.

Scholefield, Fred,

9, Lyndhurst Villas, Magdalen Road, Norwich.

Analytical Chemist. 1900—1904 received scientific training at the Yorkshire College, Leeds, specialising in Chemistry. Obtained B.Sc. (Lond.), 1902; B.Sc. (Vic.), with First Class Honours in Chemistry, 1903; A.I.C., 1904. Joint author of paper in the Society's Journal (Trans., 1904, v. **85**, p. 1432), "On the Colouring Matters of the Stilbene Group." At present Chemist to Messrs. F. Hinde & Sons, Ltd., St. Mary's Silk Mills, Norwich.

Arthur Smithells.
J. B. Cohen.
A. G. Green.
A. G. Perkin.
H. R. Procter.

Schröder, Harold,

Lithgow, N.S. Wales.

Assayer. Great Cobar Copper Mining Syndicate. Teacher of Assaying, Moonta School of Mines, S. Aus. Lecturer of Chemistry, Lithgow Technical College. Chief Assist. Chemist, Wallaroo Smelting Works, S. Aus. Chief Chemist and Assayer, G.C.C.M.Synd., Lithgow.

G. C. McMurtry. J. A. Schofield.
Edward H. Rennie. *G. A. Goyder.*
Basil Turner.

Scott, John Irwin,

Trent College, Long Eaton, Derbyshire.

Science Master. B.A. (Oxon.). First Class in Final Honours School of Natural Science (Chemistry). Eight months' work in the Erstes Chemisches Laboratorium, Leipzig, under the late Prof. J. Wislicenus.

V. H. Veley. J. E. Marsh.
W. W. Fisher. John Watts.
H. L. Bowman.

Seaton, William Dunham,

40, Argyle Road, Ilford, Essex.

Analytical Chemist, Messrs. Parke, Davis and Co., Manufacturing Chemists, Hounslow, Middlesex. Certificated Day Student (Third Year), Chemical Department, Technical College, Finsbury, Leonard Street, E.C. Late Student-Chemist, Messrs. John Brown and Co., Atlas Steel and Iron Works, Sheffield.

R. Meldola. F. Southerden.
John Castell-Evans. *Frank E. King.*
J. F. H. Gilbard.

Simmons, William Herbert,

"Oakleigh," Stoke Newington Common, London, N.

Analytical Chemist. B.Sc. (Lond.). Studied Chemistry at Finsbury Technical College and the Birkbeck Institute. For 3¼ yrs. Assistant to Dr. S. Rideal, F.I.C. For last 2 yrs., and at present, Chemist to the Vinolia Co., Ltd. Joint author with F. Hudson Cox, Esq., F.I.C., of a paper on "Otto of Rose" before the Society of Public Analysts, and contributor of notes on essential oils to the *Chemical News* and *Chemist and Druggist.*

Samuel Rideal. John E. Mackenzie.
William T. Burgess. J. W. Shepherd.
Lawrence Briant.

Troye, Gustave Arthur,

Johannesburg, P.O. Box 2706.

Consulting Engineer. Surveyor to late Transvaal Government, Compiler of Troye's Map of the Transvaal and other geographical compilations, consultant to Sundry Mining and Financial Companies. A Student of Chemistry, especially Mineral Chemistry, for many years. A member of the Institution of Mining and Metallurgy, London, where I read paper, 16th Jan., 1901.

John J. Beringer.
H. R. Beringer.
H. W. Hutchin.
A. D. Hall.
W. H. Merrett.

Want, William Phillip,

11, Pearfield Road, Forest Hill.

Editor, British and Colonial Druggist, 44, Bishopsgate Without, E.C. Pharmaceutical Chemist; Bell Scholar, Pharmaceutical Society, 1885—6. School of Pharmacy of the Pharm. Society: Chemistry and Chemical Physics, First certificate of merit, March, 1886, and First certificate of honour, July, 1886; Botany and materia medica, Bronze medal, March, 1886; First certificate of honour, July, 1886, Matriculation certificate of University of London; Senior Cambridge Local Exam. Honours (3rd class) with Distinction in English and Zoology. College of Preceptors, First Class, First Division, Special certificate in 6 subjects.

John Attfield.
Wyndham R. Dunstan.
Thomas Tyrer.
Joseph W. Swan.
Frederick B. Power.
H. A. D. Jowett.

Weiskopf, Eric H.,

Modderfontein, Transvaal.

Chief Laboratory Chemist, and Technical Chemist, Dynamite Factory, Modderfontein, B.S.A. Explosives Co., Ltd. Read paper on "Missfires, their theory, etc.," before C.M.S. of S.A. (Journal, 1902—3), do. on "The Contact Process" before S.A. Assoc. for Adv. of Sc. (In course of publication, 1904). Gave evidence before Miners' Phthisis Commission on Toxicology and kind and amount of gases of explosives. (Transvaal, Blue Book on subject, 1903). Toxicology of Nitrous Oxides (Extract in Zeitschrift für angew. Chemie, No. IV., 1904), etc., etc.

G. H. Beckett.
Oscar Guttmann.
Leo F. Guttmann.
G. G. Henderson.
Thomas Gray.

Wheeler, Ernest,

335, Park Road, Oldham, Lancs.

Analytical and Metallurgical Chemist at Messrs. Crossley Bros., Ltd., "Otto" Gas Engine Works, Openshaw, Manchester. For three years articled pupil with Messrs. Crace, Calvert, and Thomson, Royal Institution Laboratory, Manchester. Four and a half years with Messrs. Platt Bros. and Co., Ltd., Textile Manufacturers, Hartford Iron Works, Oldham, as Chief Chemist. For the last one and a half years (and at the present time) with Messrs. Crossley Bros., Ltd., Gas Engine and Gas Producer Manufacturers, as Chief Chemist.

William Thomson.	John Allan.
John Angell.	*J. Hübner.*
William J. Pope.	*J. Carter Bell.*
James Porter Shenton.	*F. S. Sinnatt.*

Wigginton, John Henry Becker,

Kennington Cross, S.E.

Analytical Chemist. General Manager of the Laboratories of Messrs. S. F. Goss, Ltd., Scientific Chemists, Wholesale and Export, 460, Oxford Street, and 201, Regent Street, London, W. Chief Chemist to the above Firm. Member of the Pharmaceutical Society of Great Britain. Certified Dispenser of the Society of Apothecaries of London. Enrolled Ophthalmic Optician, Brit. Optical Association.

A. H. M. Muter.	F. Pilkington Sargeant.
J. W. Epps.	*Chas. Turner.*

George H. Gabb.

Wilkinson, John Wells,

28, Egerton Terrace, Bexley Road, Northumberland Heath,
Belvedere, Kent.

Teacher and Chemist. Associate, i. Merchant Venturers' Technical College, Bristol (chemistry), ii. University College of Wales, Aberystwyth. M.A. (Wales); Inter. B.Sc. (London); Honours Board of Education (Theoretical and Practical). Late Teacher of Chemistry, Science School, Fairfield Road, Bristol. Late Analytical Chemist, Messrs. Francis & Co., Ltd., Cement Manufacturers, Cliffe, Kent, and Vauxhall, London.

Ernest H. Cook.	J. Wertheimer.
Jas. H. Haynes.	*Tho. W. Wormell.*

G. P. Darnell-Smith.

Williams, Alan Herbert,

127, Roseneath Road, Urmston, Nr. Manchester.

Teacher in Science Department of Urmston Secondary School. I have passed the Intermediate B.Sc. examination in Chemistry of Univ. of Wales, and worked under Professor Thompson in Cardiff University for two years, am now taking the honours course in Manchester Technical College, working under Professor Pope.

John Allan. S. J. Peachey.
W. J. Pope. *F. S. Sinnatt.*
L. G. Radcliffe.

The following Certificate was authorised for presentation to ballot by the Council under Bye-Law I. (3):

Chatterji, Hem Chandra,
Cawnpore, United Provinces of Agra and Oudh, India (East).

Professor of Physics and Chemistry, Christ Church College, Cawnpore (India). Passed the B.A. Exam. of the Allahabad University in Science Course. Attended lectures in Practical Science for the M.A. Examination for about a session. Lecturer in Ch. Ch. College for over eight years.

Gopal Ch. Banerjee. Abhayacharan Sanyal.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 28/2/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 290.

Extraordinary General Meeting, February 8th, 1905. Professor W. A. Tilden, D.Sc., F.R.S , President, in the Chair.

Forty-five Fellows were present.

The following Bye-laws were submitted by the Council for the consideration of the Fellows.

BYE-LAWS.

I.—*Of the Election, Contributions, and Rights of Fellows.*

The method of voting for the election of Fellows shall be by ballot.

Every Candidate for election into the Society as a Fellow thereof shall be proposed according to a form of certificate (see Appendix No. 1) subscribed by not less than five Fellows of the Society, to three, at least, of whom he is personally known; but in the case of a Candidate resident abroad the Council shall have the power to permit these requirements to be dispensed with if the certificate is signed by at least one Fellow of the Society to whom the Candidate is personally known. The name of each Candidate shall be read at three Ordinary Meetings, and his certificate shall be published in full in the Society's Proceedings and suspended in the Society's rooms or place of meeting until the Candidate has been duly balloted for.

Ballots shall take place at Ordinary Meetings, and those Candidates shall be balloted for whose certificates have been read at two previous Ordinary Meetings and again on the occasion of the ballot.

The election shall not be valid unless thirty-two or more Fellows vote; and until that number shall have voted the Candidate shall be balloted for at consecutive Meetings until thirty-two Fellows shall have voted on the question of the election of such Candidate. When three-fourths or more of the Fellows who vote are in favour of the Candidate, he shall be elected; but when less than three-fourths of the Fellows who vote are in favour of the Candidate, he shall not be elected. The result of the ballot shall be ascertained by two Scrutators and one of the Secretaries, and declared by the Chairman.

The person thus elected, previous to his admission, shall, within three months from the date of his election, pay an admission fee of Four Pounds, and in addition thereto his first annual subscription, or a life composition fee, otherwise his election shall be void; power to extend this period of three months being, however, reserved to the Council. He shall also return to the Secretaries the following Obligation, duly signed :—" I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Chemical Society, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue a Fellow thereof."

The annual subscription to be paid by Fellows shall be Two Pounds; except that Fellows elected before the first day of January, 1860, who have hitherto paid One Pound only, shall continue to pay at that rate. The annual subscriptions of Fellows shall become due on the first day of January in every year.

If a person be elected during the month of November or December in any year he shall not pay any annual subscription for that year, but shall not be entitled to receive the publications of the Society for that year.

The life composition fee shall be Thirty Pounds, except that Fellows who have paid ten annual subscriptions shall pay as life composition fee Twenty Pounds; Fellows who have paid fifteen annual subscriptions shall pay Fifteen Pounds; Fellows who have paid twenty annual subscriptions shall pay Twelve Pounds; and Fellows who have paid twenty-five annual subscriptions shall pay Ten Pounds.

The admission of Fellows shall take place after the reading of the Minutes at Ordinary Meetings of the Society. After the reading aloud of the prescribed form of Obligation by one of the Secretaries, the Fellow to be admitted shall subscribe his name to the Obligation in the Obligation book, and be introduced by the Secretary to the Chairman, who, taking him by the hand, and addressing him by name, shall say:—"By the authority and in the name of the Chemical Society, I admit you a Fellow thereof."

Every Fellow, so long as his annual subscription be not in arrear, shall have the right to be present and to vote at all Meetings of the Society; to propose Candidates for admission into the Society; to receive one copy of the annual publications of the Society; and shall be entitled to the use of the instruments and books in the Society's Library under such restrictions as the Council may deem necessary. He shall have the privilege of introducing to the Ordinary Meetings of the Society two visitors, whose names together with his own name shall be entered in a book kept for that purpose.

British subjects only are eligible as Fellows.

II.—*Of Honorary and Foreign Members.*

Honorary Members shall be recommended to the Society by the Council. They shall be nominated at one Meeting of the Council, and shall be balloted for at some subsequent Meeting of the Council, and if the majority of those voting are in favour of any Candidate, he shall be proposed by the Council to the Society at a subsequent Ordinary Meeting, and be balloted for according to the Rules for the election of Fellows at the Ordinary Meeting following that at which he was recommended for election.

The number of Honorary Members shall not exceed forty. They shall not be required to contribute to the Funds of the Society, but shall be entitled to receive a copy of the annual publications of the Society.

Persons who are not British subjects may be proposed for election as Foreign Members, and may be elected in the manner prescribed for the election of Fellows; such Foreign Members shall pay the same contribution as the Fellows and shall enjoy the same privileges, except that they shall not vote at any Meeting of the Society.

III.—*Of Associates.*

Associates may be of either sex and shall be proposed, balloted for and elected in the same manner as Fellows. They shall not be required to pay an admission fee, but shall pay an annual subscription of Two Pounds, which shall become due on the first day of January in every year. They shall also return to the Secretaries the following Obligation, duly signed:—"I, the undersigned, do hereby engage that

I will endeavour to promote the interests and welfare of the Chemical Society, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue an Associate thereof."

Associates shall have all the ordinary privileges of Fellows so long as their annual subscriptions be not in arrear, except that they shall neither vote at Meetings of the Society nor propose Candidates for election.

IV.—*Of the Resignation, Re-admission, and Removal of Fellows, Honorary Members, Foreign Members and Associates.*

The Council shall have the power to decline to accept the resignation of any Fellow, Foreign Member or Associate so long as any moneys remain due from such person to the Society.

Any Fellow, Foreign Member or Associate who at any Annual General Meeting of the Society shall owe two annual subscriptions, payment whereof shall have been applied for by the Treasurer by means of a notice addressed and posted to each person so in arrear not later than the first day of January immediately preceding such meeting and for the non-payment whereof no reason satisfactory to the Council shall have been given, shall cease to be a Fellow, Foreign Member or Associate of the Society, and the name shall be removed from the Society's List accordingly as from that date: Provided, nevertheless, that on an application for re-admission being addressed to the Council by such person within three years from the date of the removal of the name from the Society's List, the case shall be considered by the Council, who may, if they see fit, reinstate such person as a Fellow, Foreign Member or Associate of the Society as the case may be upon payment of all arrears of subscriptions, or upon payment of the amount of the life composition fee which would have been payable at the date when the first subscription in arrear was due.

No application for re-admission shall be considered by the Council after the lapse of three years from the resignation of a Fellow, Foreign Member or Associate, or from the removal of the name from the Society's List, but such person desiring again to become a Fellow, Foreign Member or Associate may be proposed, balloted for and elected as a new Candidate for election. Provided always that no person whose name was removed from the Society's List for non-payment of subscriptions shall be eligible for re-election until all subscriptions due at the time when the name was removed shall have been paid.

Any proposal to remove the name of a Fellow, Honorary Member, Foreign Member or Associate from the Society's List for other causes than the non-payment of subscriptions must be made by the Council.

It shall be made at an Ordinary Meeting, and the removal be balloted for at the next Ordinary Meeting, and if three-fourths of the Fellows voting shall vote for such removal, the name of the Fellow, Honorary Member, Foreign Member or Associate shall be removed from the Society's List accordingly, provided always that not less than forty Fellows vote on the question of removal.

V.—*Of the Constitution and Election of the Council.*

The President, Vice-Presidents, Treasurer and Secretaries (herein called "the Official Members of Council") and twelve other Fellows (herein called "the Ordinary Members of Council") forming the Council to conduct the business of the Society under the Charter, shall be elected by ballot at the Annual General Meeting, and all Members of the Council shall hold office until the next Annual General Meeting, and be eligible for re-election, except as otherwise provided by the Bye-laws.

The Council may act notwithstanding any casual vacancy in their body so long as the number of Ordinary Members is not reduced below eight.

At the second Ordinary Meeting in February the Chairman shall declare: 1st. The names of the Official and Ordinary Members of Council who become ineligible for the succeeding year, according to the Bye-laws, either for the Council or for specific Offices. 2nd. The names of the President and Official Members recommended by the Council for election to office during the ensuing year, including the names of two new Vice-Presidents selected either from the existing Council or from the general body of Fellows. 3rd. The names of new Ordinary Members recommended by the Council for election in the place of the Ordinary Members becoming ineligible as Ordinary Members or being recommended by the Council for election as Official Members.

Any Fellow or Fellows other than those recommended by the Council may be proposed for election as Official or Ordinary Members on the nomination of ten Fellows. The proposal in writing duly signed by the nominators shall be communicated to one of the Secretaries before the first Ordinary Meeting in March, specifying the name or names of the Candidate or Candidates, and the position (Official or Ordinary) on the Council for which each Candidate is nominated; and the list of names proposed shall be read from the Chair and be publicly suspended in the Society's rooms and circulated among the Fellows with the list recommended by the Council.

No person shall be eligible for any position on the Council unless nominated for that position in accordance with these Bye-laws.

Two lists, according to the Forms Nos. 5 and 6 in the Appendix, with the names of the Fellows recommended for election as Official and Ordinary Members of Council, and having each a blank column opposite for such alterations as any Fellow may wish to make in accordance with these Bye-laws and the instructions on the forms, shall be prepared by the Secretaries. These two lists shall be read from the Chair at the first Ordinary Meeting in March, and, on or before the day of meeting, shall be suspended in the Society's rooms and circulated among the Fellows.

On the day of Election, two Scrutators shall be nominated by the Chairman, with the approbation of the Meeting, to assist the Secretaries in examining the lists. Each Fellow voting shall deliver his list to one of the Scrutators, and the name of the Fellow so voting shall be recorded by one of the Secretaries. The names of those reported to the Chairman by the Scrutators as having the majority of votes of the Fellows present for filling the offices of President, Vice-Presidents, Treasurer, Secretaries and Ordinary Members of Council shall then be announced from the Chair as elected to serve for the ensuing year.

In the event of votes being recorded for the same Candidate, both as an Official and an Ordinary Member of Council, the votes recorded for him as an Official Member shall, in the case of his not being elected an Official Member, be added to those recorded for him as an Ordinary Member of Council, and the total number of votes shall be counted as votes for the Candidate as an Ordinary Member of Council.

VI.—*Of the President.*

It shall be the duty of the President to preside at the Meetings of the Society and of the Council, and to regulate the order of the proceedings.

No Fellow shall be elected as President of the Society for more than two years in succession, but he may be re-elected after the lapse of one year.

In case of a casual vacancy, the Council may elect one of the Vice-Presidents to exercise the Powers and perform the duties of President until the next Annual General Meeting.

VII.—*Of the Vice-Presidents.*

In the absence of the President, the Chair shall be occupied by one of the Vice-Presidents, or, in the absence of any Vice-President, by a Member of Council or some other Fellow.

Fellows who have filled the office of President shall be proposed by the Council for election as Vice-Presidents, and such proposal shall be renewed every year, except when any such Vice-President shall be nominated to the office of President.

There shall also be six Vice-Presidents who have not filled the office of President. At the Annual General Meeting in every year, four only of these Vice-Presidents shall be eligible for election as Members of the Council for the ensuing year, and if a Vice-President (not being a Past President) shall be nominated by the Council for election as President, four of the remaining above-mentioned Vice-Presidents shall be eligible. The Council shall decide which Vice-Presidents or Vice-President shall so be eligible.

In case of a casual vacancy in the number of Vice-Presidents (not being Past Presidents), the Council may elect a Vice-President who shall remain in office until the next Annual General Meeting.

VIII.—*Of the Treasurer.*

The Treasurer shall receive all moneys due to the Society, and shall pay and disburse out of the Society's funds such sums as may be ordered by the Council. He shall keep an account of such receipts and payments, in which donations and moneys received for composition of annual payments shall be entered separately from the ordinary revenues of the Society, and he shall produce such account at any Meeting of the Council, when required.

The Treasurer shall pay all moneys received by him into the hands of the Society's bankers, and shall make up his Accounts to the end of each year for the examination of the Auditors.

The Treasurer shall, before the last day of each year, send to every Fellow and Foreign Member of the Society who has not compounded for his annual contribution, and to every Associate, an intimation that their contributions for the ensuing year become due on the first day of January.

At the second Ordinary Meeting of the Society in February, three Auditors shall be elected by the Society by show of hands unless a ballot be demanded. They shall audit the Treasurer's Accounts, and shall forward their Report to the Council at least one week before the

Annual General Meeting, together with a list, prepared by the Treasurer, of all Fellows, Foreign Members and Associates whose subscriptions are in arrear. They shall have the power of calling for all necessary accounts and vouchers. No member of the Council shall be eligible as an Auditor.

The Council shall fill up any casual vacancy in the office of Treasurer or Auditor occurring in any year.

IX.—*Of the Secretaries.*

There shall be two Secretaries and a Foreign Secretary.

The duties of the Secretaries shall be—1st. To attend, one or both, at all Meetings of the Society and of the Council. 2nd. To take minutes of the proceedings, and to read them at the ensuing Meeting. 3rd. To read at the Ordinary Meetings such Communications to the Society, or abstracts thereof, as the Chairman may direct. 4th. To send to every person elected into the Society notice of his election, and a printed copy of the Obligation, together with a copy of the Charter and Bye-laws of the Society and a List of the Fellows, Honorary Members, Foreign Members and Associates. 5th. To prepare and circulate the Balloting Lists of the Council. 6th. To conduct the home correspondence of the Society, and such other secretarial business as is reasonably to be inferred from the Charter and Bye-laws. The several duties to be performed by each Secretary shall be arranged by the Council.

The Secretaries shall keep the Obligation book and a book containing the Bye-laws with the form of Obligation to be subscribed by each Fellow, Foreign Member or Associate.

The Foreign Secretary shall conduct the foreign correspondence of the Society.

The Council shall fill up any casual vacancy in the Office of Secretary or Foreign Secretary occurring in any year.

X.—*Of the Ordinary Members of Council.*

At the Annual General Meeting in every year eight only of the Ordinary Members of Council shall be eligible for election for the ensuing year. The Council shall decide which eight members shall be eligible. The Council shall as far as possible arrange the rotation and nominations so that three-fourths of the Ordinary Members of Council are resident within sixty miles of the rooms of the Society.

The Council may fill up casual vacancies among the Ordinary Members of Council and shall do so if necessary to prevent the number of Ordinary Members of Council from falling below eight.

XI.—*Of the Proceedings of the Council.*

The Council shall hold their Ordinary Meetings at least once a month, from November to June inclusive.

Extraordinary Meetings of the Council shall be called by the President upon a requisition to him signed by three members of the Council, or at his own discretion, when he shall direct the Secretaries to issue summonses for the occasion.

Notice of the time of holding each Meeting of the Council shall be forwarded by one of the Secretaries to each Member of the Council at least two days previous to that on which such Meeting is to be held, but the non-receipt of such notice by any Member of the Council shall in no way invalidate the proceedings of the Meeting.

Five Members of the Council shall form a quorum at all meetings of the Council.

The ordinary mode of decision on questions before the Council shall be by show of hands, unless a ballot be demanded. Any Member of the Council who shall be personally concerned in the question under consideration shall retire during the discussion and determining of the same and shall not vote thereon.

At the Annual General Meeting, the President shall present the Report of the Council on the state of the Society during the past twelve months.

Before any new Bye-law, or alteration of the existing Bye-laws, be brought before the Society by the Council, it shall be proposed at one Meeting of the Council, and considered and approved of at a subsequent Meeting.

The Council shall have the power of appointing and of removing the Assistant Secretary, Librarian, Curator, and any other paid Officers of the Society, and of determining which of the Officers of the Society shall receive remuneration and the rate thereof and the nature and extent of the service to be rendered by each Officer.

XII.—*Of the Ordinary Meetings of the Society.*

Ordinary Meetings of the Society shall be held twice in every month from November to June inclusive, and if the Council see fit there shall be one Meeting in the month of October, provided that in the month of January and in the month in which Easter occurs, the Council may dispense with one of the Meetings: the specific days and hours of meeting shall be determined by the Council.

The ordinary course of business shall be as follows, subject, however, to the control of the Chairman for the time being:—1st. The names of the visitors, and of the Fellows or Associates by whom they are introduced, shall be announced from the Chair. 2nd. The Minutes of the proceedings of the previous Meeting shall be read and submitted for confirmation. 3rd. New Fellows shall sign the Obligation book, and shall be admitted by the Chairman. 4th. Presents made to the Society since its last Meeting shall be announced from the Chair. 5th. The certificates of Candidates for election shall be read. 6th. The ballot (if any) for any election shall be opened. 7th. Communications shall be read and discussed.

XIII.—*Of the General Meetings of the Society.*

An Annual General Meeting of the Society shall be held on the 30th day of March, or on some day near that time, and at such an hour as the Council may determine.

An Extraordinary General Meeting of the Society shall be summoned at any time by the President on his receiving a written requisition to do so from the Council or from twenty Fellows of the Society. Notice shall be given of such Meeting at a previous Ordinary Meeting, and by a circular addressed to all the Fellows who have given to the Secretaries an address in the United Kingdom for the purpose of sending publications or notices. The President shall have the power of calling an Extraordinary General Meeting at any time.

At all General Meetings, whether Annual or Extraordinary, no motion of a proposal to alter the Bye-laws shall be considered of which due notice has not been given at least fourteen days previously, either at an Ordinary Meeting, or by Publication in the Proceedings, and in either case by means of a printed notice subsequently addressed to all Fellows having a postal address in the United Kingdom known to the Secretaries.

For the purpose of any alteration of the Bye-laws the quorum of the Meeting, Annual or Extraordinary, shall be sixty.

XIV.—*Of the Reading and Publication of Papers.*

The Secretaries, or one of them, shall mark upon each paper the date on which it was received from the author, and also the date, if any, on which it was read to the Society. These papers or abstracts thereof, or the titles thereof, shall be read at Ordinary Meetings, and the discussion of each paper shall immediately follow the reading thereof, unless the Chairman for the time being shall otherwise direct. The discussion of any paper may, on a resolution of the Meeting to that effect, be resumed at a subsequent Meeting. The Council may decide that any paper shall not be read at any Meeting.

Papers received during the recess may be ordered for publication by the Council without being read to the Society.

All papers communicated to the Society as aforesaid, with their illustrative Drawings, shall become the property of the Society; and authors shall not be at liberty, save by permission of the Council, to publish in English such papers, until the same, or abstracts thereof, have either appeared in the Journal of the Society, or the Secretaries have notified the authors that the same, or abstracts thereof, will not appear in the Journal of the Society.

The Journal of the Society shall be published at intervals to be determined by the Council. It shall contain such of the papers which have been read at the Meetings of the Society, or abstracts of them, as the Council may determine, together with abstracts of papers published in other Journals.

XV.—*Of the Library.*

The books in the possession of the Society shall be allowed to circulate under such regulations and with such exceptions as the Council may deem advisable.

XVI.—*Of the Common Seal and Deeds.*

The Common Seal of the Society shall remain in the custody of the President. Every Deed or Writing to which the Common Seal is to be affixed shall be passed and sealed in Council.

APPENDIX.

No. 1.

CHEMICAL SOCIETY.

Certificate of a Candidate for Election as a Fellow.

The attention of the Candidate in whose favour this Certificate is made out is specially directed to the fact that, if elected, he will be required to sign the following Obligation, prior to his admission into the Society :—

> Obligation.—I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Chemical Society, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue a Fellow thereof.

Name ______________________________

Usual Place of Residence

Designation or Occupation

Qualifications.*

being desirous of admission into the Chemical Society, *we, the undersigned, propose and recommend him as a proper person to become a* Fellow *thereof.*

* Directions for filling up the Certificate are given on the other side.

Dated this ______ *day of* ______ 19

From Personal Knowledge.	From General Knowledge.

Proposed on ____________

To be Balloted for on ____________

Elected ____________ 19

____________ *President.*

Directions for filling up the Certificate of a Candidate for Election as a Fellow.

Under "Qualifications" should be given a concise statement of the Candidate's contributions to Chemical Science as Investigator or Author, or of his position and past experience as Lecturer, Teacher, Assistant or Student or in connection with Analytical or Manufacturing Chemistry.

If the Candidate's qualifications are not included under any of the above heads, the reasons for his desiring admission to the Society should be stated.

The Certificate must be signed by *five* or more Fellows, of whom *at least three* must certify their recommendation from *personal* knowledge.

⁂ In conformity with Bye-law I, this Certificate will be published in full in the "Proceedings of the Chemical Society."

No. 2.

CHEMICAL SOCIETY.

Certificate of a Candidate for Election as an Associate.

The attention of the Candidate in whose favour this Certificate is made out is specially directed to the fact that, if elected, will be required to sign the following Obligation prior to admission into the Society :—

> OBLIGATION.—I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the CHEMICAL SOCIETY, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue an ASSOCIATE thereof.

Name ____________

Usual Place of Residence ____________

Designation or Occupation ____________

Qualifications.*

being desirous of admission into the Chemical Society, *we, the undersigned, propose and recommend* *as a proper person to become an* Associate *thereof.*

* Directions for filling up the Certificate are given on the other side.

Dated this ______________ *day of* ______________ 19

From Personal Knowledge. | From General Knowledge.

Proposed on ______________________

To be Balloted for on ______________________

Elected ______________ 19

____

President.

Directions for filling up the Certificate of a Candidate for Election as an Associate.

Under "Qualifications" should be given a concise statement of the Candidate's contributions to Chemical Science as Investigator or author, or of position and past experience as Lecturer, Teacher, Assistant or Student or in connection with Analytical or Manufacturing Chemistry.

If the Candidate's qualifications are not included under any of the above heads, the reasons for desiring admission to the Society should be stated.

The Certificate must be signed by *five* or more Fellows, of whom *at least three* must certify their recommendation from *personal* knowledge.

⁂ In conformity with Bye-law I, this Certificate will be published in full in the "Proceedings of the Chemical Society."

No. 3.

Obligation.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the CHEMICAL SOCIETY, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue a FELLOW thereof.

Signed ______

Address

In the presence of

Address

Date ______

No. 4.

Obligation.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the CHEMICAL SOCIETY, that I will observe its Laws, and to the utmost of my power maintain its dignity, as long as I shall continue an ASSOCIATE thereof.

Signed ______

Address ______

In the presence of

Address ______

Date ______

[*Issued by authority of the Council.*] No. 5. [*March*, 19 .]

Balloting List for the Election of Official Members of Council.

CHEMICAL SOCIETY. — BALLOTING LIST

FOR THE ELECTION OF OFFICIAL MEMBERS OF COUNCIL.

Present.	*Proposed by Council.*	
PRESIDENT.		
VICE-PRESIDENTS WHO HAVE FILLED THE OFFICE OF PRESIDENT.		
VICE-PRESIDENTS.		
TREASURER.		
SECRETARIES.		
FOREIGN SECRETARY.		

The following are names proposed under the Bye-laws for election to the respective offices in lieu of the above :—

PRESIDENT ... ...

VICE-PRESIDENTS...

TREASURER ... ...

SECRETARIES ... ...

FOREIGN SECRETARY

If you wish to substitute any other name, in place of that proposed by the Council, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute. Erasures without substitution, or substitution of other names than those duly proposed under the Bye-laws, will have no effect.

[*Issued by authority of the Council.*] No. 6. [*March*, 19 .]

Balloting List for the Election of Ordinary Members of Council.

CHEMICAL SOCIETY. — BALLOTING LIST

FOR THE ELECTION OF ORDINARY MEMBERS OF COUNCIL.

Present.	*Proposed by Council.*	

The following are names proposed under the Bye-laws in lieu of the above :—

If you wish to substitute any other name, in place of that proposed by the Council, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute. Erasures without substitution, or substitution of any names other than those duly proposed under the Bye-laws, will have no effect.

Before proceeding to invite discussion of the revised Bye-laws, the President said he thought it would be desirable that a short statement of the course of events relating to this matter should be laid before the meeting. It appeared that the last complete revision of the Bye-laws was undertaken in 1878, when the total Membership of the Society, including 1 Associate and 35 Honorary Foreign Members, was 974. With the exception of minor alterations dealing with the issue of the publications of the Society to Fellows whose subscriptions are in arrear, the Bye-laws then adopted are those in force at the present time.

During the last twenty-five years the growth of the Society had been rapid and the need for a complete revision of the Bye-laws had forced itself on the attention of the Council in the course of the last decade, leading eventually in 1897 to the appointment of a Committee to consider the question. In the end no action was taken on the report of the Committee and no further progress was made until June of last year, when the Council appointed a Committee "to revise the Bye-laws." This Committee consisted of the Officers with Mr. David Howard, Dr. Hugo Müller, Professor J. M. Thomson, Dr. T. E. Thorpe, and Mr. Phipson Beale, K.C. In the course of the recess, a comprehensive series of suggestions was made, chiefly by Mr. Beale, to whom the Council were deeply indebted for his valuable assistance. These, together with amendments proposed in writing by other members of the Committee, were circulated among the members of the Committee and were discussed at the first meeting of the Committee on October 26th. Two lengthy meetings were required to complete the first revision. The Bye-laws as revised were circulated among the members of the Committee, and in two meetings the second revision was completed. It should be added that subsequently the revised Bye-laws were submitted to the Society's solicitor, Mr. Carpmael, and three interviews with him took place during the preparation of the final draft which formed the Report of the Committee to the Council.

The Council, as required by Bye-law X, had the Bye-laws before them at two meetings. The revised Bye-laws having been formally proposed on December 14th, 1904, were considered and adopted on January 18th, 1905, Mr. Carpmael being present on the latter occasion to advise the Council during the discussion.

The process of revision had therefore been undertaken by the Council with great deliberation and with every precaution to secure consistency among the new Bye-laws and compliance with the terms of the Charter.

In order to facilitate comprehension of the changes which were proposed, independently of merely verbal amendments, the following points might be enumerated as representing substantial alterations in the several Bye-laws.

Distinction of Honorary from merely Foreign Members (Bye-law II).

Extension of the Associateship to Women (Bye-law III).

Power to fill up casual vacancies among the Official and Ordinary Members of Council (Bye-laws VI, VII, VIII, IX, and X).

Extension of town membership of Ordinary Members of Council to Fellows resident within 60 miles of the Society's rooms (Bye-law X).

Precise definition of the mode of election of the Council, and of the nomination of Fellows other than those proposed by the Council (Bye-law V).

It was moved by Dr. Divers, and seconded by Dr. Moody:

> That the proposed Bye-laws be sent up to the Council for revision and co-ordination without altering the sense.

This motion was withdrawn.

It was moved by Dr. Divers, and seconded by Prof. Dunstan:

> That the Bye-laws proposed by the Council be accepted, and the Council requested to carefully consider the suggestions for verbal improvement made by Dr. Divers, and to adopt such improvements as can be introduced without legal objection.

As an amendment, it was moved by Mr. D. A. Sutherland, and seconded by a Fellow:

> That the Meeting be adjourned until the Council has considered the suggestions made by Dr. Divers.

As a further amendment it was moved by Mr. F. J. Lloyd, and seconded by Dr. Barger:

> That the proposed Bye-laws be referred back to the Council for further consideration.

This amendment was put to the vote, and by 23 votes to 10 votes it was resolved:

> That the proposed Bye-laws be referred back to the Council for further consideration.

Wednesday, February 15th, 1905. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Mr. A. W. Henzell was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Arthur Amos, B.A., Spring Grove, Wye, Kent.
William Morris Colles, jun., B.Sc., 16, Birchington Road, West Hampstead, N.W.
Miles Coupe, 46, Millarborn Lane, Waterfoot, near Manchester.
John William Taylor, University College, Reading.

It was announced that the following changes in the Officers and Council were proposed by the Council.

As President: Prof. R. Meldola, F.R.S., *vice* Prof. W. A. Tilden, F.R.S.

As Vice-Presidents: Prof. A. Smithells, F.R.S., and Prof. W. P. Wynne, F.R.S., *vice* Prof. P. F. Frankland, F.R.S., and Prof. R. Meldola, F.R.S.

As Secretary: Prof A. W. Crossley, *vice* Prof. W. P. Wynne, F.R.S.

As Ordinary Members of Council: Mr. E. C. C. Baly, Dr. G. T. Moody, Mr. W. J. Sell, F.R.S., and Dr. J. Wade, *vice* Dr. A. Harden, Dr. J. T. Hewitt, Dr. C. A. Kohn, and Dr. S. Ruhemann.

Mr. E. Grant Hooper, Dr. H. F. Morley, and Dr. J. Wade were elected to audit the Society's accounts.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected.

Andrea Angel, M.A.
Francis William Fredk. Arnaud.
James Henry Ashwell.
James Hector Barnes, B.Sc.
Samuel Henry Clifford Briggs, B.Sc.
James H. Campbell.
Hem Chandra Chatterji, B.A.
F. E. Clarke, Ph.D., B.Sc.
George Douglas Clarkson.
Bernard Collett.
Samuel George Eade.
Charles Richard Gardner.
Herbert Goodier.
Frederick William Heely.
James Alexander Russell Henderson, B.Sc.
Carl Richard Hennings, Ph.D.
Bernard Mount Jones, B.A.
Percy Walter Jones.
Tudor Foulkes Jones, B.Sc.
Herbert Louis Leech.
Joseph Lister, B.Sc.
George Moss Lloyd, M.A., M.Sc.
Edward William Lucas.
Alfred Courtenay Luck.
Andrew Norman Meldrum, D.Sc.

William Sloan Mills, M.A.
Charles Watson Moore, B.Sc.
Thomas Pennycuick, B.Sc.
Bert Perrott.
Frank Lee Pyman, B.Sc., Ph.D.
Ernest Quant.
William Henry Ratcliffe, B.Sc.
Frederick George Richards.
Harold Rudolph Rogers, B.A.
Fred Scholefield, B.Sc.
Harold Schröder.
John Irwin Scott, B.A.
William Dunham Seaton.
William Herbert Simmons, B.Sc.
Gustav Arthur Troye.
William Phillip Want.
Eric H. Weiskopf.
Ernest Wheeler.
John Henry Becker Wigginton.
John Wells Wilkinson, M.A.
Alan Herbert Williams.

Of the following papers, those marked * were read:

*16. "Nitrogen halogen derivatives of the aliphatic diamines." By Frederick Daniel Chattaway.

Although the quinonedichloroimides, obtained from the aromatic diamines, were among the earliest studied nitrogen halogen compounds, no derivatives of the aliphatic diamines have hitherto been described. Both the diamines themselves and the diacyldiamines, however, readily yield such substances in which the whole of the hydrogen attached to nitrogen is replaced by halogen, and a number of such derivatives of ethylenediamine and trimethylenediamine have been prepared. The most noteworthy of the compounds described were ethylenetetrachlorodiamine, $NCl_2\cdot CH_2\cdot CH_2\cdot NCl_2$, and ethylenetetrabromodiamine,

$$NBr_2\cdot CH_2\cdot CH_2\cdot NBr_2;$$

both are stable substances, the former a liquid giving off peculiarly irritating vapours, the latter a well crystallised solid.

*17. "The nitration of substituted azophenols." By John Theodore Hewitt and Herbert Victor Mitchell.

The authors have systematically studied the action of dilute nitric acid and of a mixture of concentrated nitric and sulphuric acids on the three nitrobenzeneazophenols. With dilute nitric acid, substitution takes place in the ortho-position with respect to the hydroxyl group in each case (compare *Trans.*, 1900, **77**, 99; 1901, **79**, 49, 155); it is, however, remarkable that the concentrated mixed acids have the same effect.

This result contradicts Noelting's statement (*Ber.*, 1887, **20**, 2997) to the effect that if benzeneazophenol is dissolved in concentrated sulphuric acid and treated with one molecule of nitric acid, *p*-nitrobenzeneazophenol results; whilst with two molecules of nitric acid a product is obtained identical with that derived from the diazotisation of 2:4-dinitroaniline and subsequent coupling with phenol.

Whilst Noelting is correct in stating that the first nitro-group enters the benzene nucleus in the para-position with respect to the azo-group, he is obviously wrong as to the position assumed by the second nitro-group, since *p*-nitrobenzeneazophenol, when dissolved in concentrated sulphuric acid and treated with one molecular proportion of nitric acid, furnishes a product which melts at the same temperature and does not depress the melting point of the product of coupling *p*-nitrophenyldiazonium salts with *o*-nitrophenol.

The evidence as to the constitution of the product obtained by nitrating *m*-nitrobenzeneazophenol is as follows: (i) the same product is obtained by nitration with strong and dilute acids, (ii) it has the same melting point as the product obtained by the action of strong sulphuric acid on 3 : 3′-dinitroazoxybenzene.

o-*Nitrobenzeneazo*-o-*nitrophenol* (m. p. 187°) has been obtained not only by nitration of *o*-nitrobenzeneazophenol, but also by coupling *o*-nitrophenyldiazonium sulphate with *o*-nitrophenol; its *acetyl* and *benzoyl* derivatives melt at 119° and 174° respectively.

m-Nitrobenzeneazo-*o*-nitrophenol melts at 179°; its *acetyl* and *benzoyl* derivatives melt at 138° and 169° respectively.

p-Nitrobenzeneazo-*o*-nitrophenol melts at 212° (Noelting gives 200°); its *acetyl* and *benzoyl* derivatives melt at 138° and 179° respectively.

2-*Nitrotoluene*-4-*azophenol* melts at 186°, its *acetyl* derivative at 113°. 3-*Nitrotoluene*-4-*azophenol* melts at 158°.

The last two azo-compounds have been obtained by coupling the diazotised nitro-*p*-toluidines with phenol, but not by nitrating *p*-tolueneazophenol.

*18. "The estimation of saccharin." By Charles Proctor.

The "sulphate" and "salicylic acid" methods of estimating saccharin are troublesome, and require great attention to details in order to obtain satisfactory results.

The process described by E. Emmet Reid (*Amer. Chem. Journal*, 1899, **21**, 461) for the estimation of real saccharin (*o*-benzoicsulphinide), by boiling with dilute acid (which hydrolyses this compound to the acid ammonium salt of sulphobenzoic acid) and then distilling off and estimating the ammonia so produced, has been tested and found to be convenient and reliable.

The paper also describes a simple volumetric process by means of which the combined percentage of real saccharin (*o*-benzoicsulphinide) and *p*-sulphamidobenzoic acid in commercial samples and mixtures containing saccharin can be readily determined. This process depends on the liberation of iodine by both real saccharin and *p*-sulphamidobenzoic acid, when either or both are mixed with a solution containing potassium iodide and iodate.

By a combination of this "iodine process" with the "ammonia process," the separate percentages of "para-" and "ortho-saccharin" can be readily determined, and then indirectly that of any unaltered sulphonamide, &c.

19. "The analysis of samples of milk referred to the Government Laboratory in connection with the Sale of Food and Drugs Acts." By Thomas Edward Thorpe.

In connection with the administration of the Sale of Food and Drugs Acts, samples of milk are frequently referred by magistrates to the Government Laboratory for examination. These referred samples are invariably sour when received, and it is therefore of importance to determine whether this fact prevents a true inference as to the character of the fresh milk or interferes with the determination of the degree of sophistication to which the milk may have been subjected.

The charges usually brought against milk by public analysts are that it has been mixed with water or that fat has been abstracted. The proof or disproof of the allegation depends upon a determination in the sample of the amount of fat and of the non-fatty solids.

As regards the fat, it would appear that bacteria producing steatolytic enzymes do not develop to any considerable extent in sour milk. Direct experiments show that any action they may produce is too inconsiderable to affect to any substantial extent the experimental proof of the validity of any charge based upon an alleged deficiency in fat.

As regards a charge based upon an alleged deficiency of non-fatty solids, as the aggregate weight of the non-fatty solids is affected to some extent by the fermentative changes associated with the souring, it has been necessary to examine these changes in some degree of detail with a view to ascertain their bearing upon the experimental facts needed to establish the inference of sophistication, and to determine its extent.

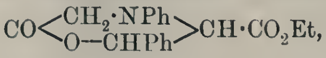
This communication contains the results of such an examination. It serves to establish the character of the products of the change in so far as they affect the quantitative results, describes how they may be determined, and what is the nature and amount of the correction needed to account for the slight loss in the non-fatty solids which generally results on keeping the milk.

20. "The condensation of anilinodiacetic esters in presence of sodium ethoxide." By Alfred Theophilus de Mouilpied.

The esters and half-esters of anilino- and toluidino-diacetic acids and anilinoacetylpropionic acid and certain of its esters were prepared and condensed either alone or in the presence of benzaldehyde or ethyl oxalate by means of sodium ethoxide.

Sodium ethoxide does not bring about ring formation in the case of the anilinodiacetic esters, these substances behaving like glutaric esters.

Ethyl anilinoacetylpropionate loses one molecule of alcohol and gives ethyl phenyloxypyrrolinecarboxylate; this ester on saponification gives the acid, which in its turn loses carbon dioxide on heating. In alcoholic solutions, sodium ethoxide only saponifies the esters.

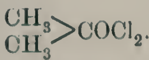
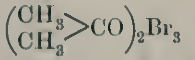
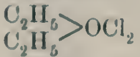
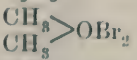
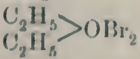
With benzaldehyde, ethyl anilinodiacetate condenses to a lactone having the constitution  $CO<\begin{matrix}CH_2\cdot NPh\\O-CHPh\end{matrix}>CH\cdot CO_2Et$, which yields the acid on saponification.

Alcoholic solutions of anilino- and toluidino-diacetic esters, when treated with ammonia, yield the corresponding diamides.

Sodium ethoxide readily brings about a condensation between ethyl anilinodiacetate and ethyl oxalate, yielding a substance having very different properties from the ketopentamethylene derivatives obtained by Dieckmann with ethyl glutarate. The product has the composition $C_{16}H_{17}O_6N$ and probably a quinonoid structure. On using methyl oxalate, a different compound was obtained, as also on substituting sodium methoxide for the ethoxide. Similar experiments were carried out with methyl anilinodiacetate.

21. "The basic properties of oxygen at low temperatures: additive compounds of the halogens with organic substances containing oxygen." By Douglas McIntosh.

It was previously shown (Walker, McIntosh, and Archibald, *Trans.*, 1904, **85**, 1098; Archibald and McIntosh, 1904, **85**, 919) that organic compounds containing oxygen united, at low temperatures, with the halogen hydrides to form definite compounds. Continuing these low temperature experiments with chlorine and bromine, the following compounds were made:

	M. p.		M. p.
CH_4OBr	–55°	 $\begin{matrix}CH_3\\CH_3\end{matrix}>COCl_2$	–53°
C_2H_6OBr	–61	 $\left(\begin{matrix}CH_3\\CH_3\end{matrix}>CO\right)_2Br_3$	–12
 $\begin{matrix}C_2H_5\\C_2H_5\end{matrix}>OCl_2$	–51	$CH_3\cdot CO_2(C_2H_5)Cl_3$	–64
 $\begin{matrix}CH_3\\CH_3\end{matrix}>OBr_2$	–68	$CH_3\cdot CO_2(C_2H_5)Br_3$	–39
 $\begin{matrix}C_2H_5\\C_2H_5\end{matrix}>OBr_2$	–40	$(CH_3\cdot COH)_3Cl_2(?)$	–11

These formulæ must, in some cases, be doubled in order to represent the constitutions of the compounds with oxygen as a quadrivalent element.

These substances are formed with the evolution of a small amount of heat, have definite melting points, and crystallise in needles or prisms. At a low temperature ($-80°$), there is no substitution and only additive compounds are produced.

Compounds of chlorine with the alcohols and with methyl ether were not obtained, but would doubtless crystallise out at a lower temperature. Compounds were made with the halogens and acetic acid, but difficulty was experienced in preventing the acetic acid from being precipitated, so that the analyses varied widely and showed a large amount of acid present. The halogens form compounds with acetaldehyde, but these are quickly decomposed and a mixture of meta- and para-acetaldehydes results. Iodine is the most powerful of the halogens in bringing about this change, whereas chlorine is the least.

22. "Organic derivatives of silicon." By Frederic Stanley Kipping.

The continuation of this work (*Proc.*, 1904, **20**, 15), in which the author has been assisted by Mr. A. Hunter, has led to the preparation of a number of compounds of which the following is a brief preliminary account; for the purpose of systematic nomenclature, these compounds may be conveniently regarded as derivatives of *silicane*, SiH_4, or of *silicol*, $SiH_3{\cdot}OH$.

Diphenylethylchlorosilicane, $SiEtPh_2Cl$, is obtained as a by-product in the preparation of phenylethyldichlorosilicane (phenylethylsilicon dichloride); it is a fuming liquid boiling at about 240° (115 mm.).

Phenylethylpropylchlorosilicane, SiEtPrPhCl, is the principal product of the interaction of phenylethyldichlorosilicane and magnesium propyl bromide; it boils at about 255°, but has not been obtained quite free from impurity.

Phenylmethylethylpropylsilicane, SiMeEtPrPh, is obtained when the preceding compound is treated with magnesium methyl iodide; it is a mobile liquid, boiling at 229—231°, and is decomposed by sulphuric acid giving, apparently, benzene and *methylethylpropylsilicol,* $SiMeEtPr{\cdot}OH$.

Phenylbenzylethylpropylsilicane, SiEtPrPhBz, prepared from magnesium benzyl chloride and phenylethylpropylchlorosilicane, is a colourless liquid, boiling at 249—251° (100 mm.), and is readily decomposed by sulphuric acid, giving benzene and *benzylethylpropylsilicol,* $SiEtPrBz{\cdot}OH$, or the corresponding *ether,* $(SiEtPrBz)_2O$.

When this decomposition product of phenylbenzylethylpropylsilicane is heated with sulphuric acid, it undergoes sulphonation, giving apparently various acids of which hitherto only one has been isolated. This compound seems to be benzylethylpropylsilicolsulphonic acid and has apparently the composition $SiEtPr(OH)\cdot CH_2\cdot C_6H_4\cdot SO_3H$, but it may be derived from the corresponding ether (see below); its *ammonium* salt crystallises well in colourless plates and is very readily soluble in water; its *barium* salt separates from aqueous alcohol in well-defined crystals and is almost insoluble in water; its l-*menthylamine* salt crystallises well from aqueous alcohol and melts at about 230°; its *bornylamine* salt also crystallises well and melts at about 211°; the salts of most of the alkaloids do not crystallise readily.

Benzylethyldichlorosilicane, $SiEtBzCl_2$, prepared by treating ethyltrichlorosilicane with magnesium benzyl chloride, is a colourless, fuming liquid boiling at 168—170° (100 mm.), and is separated from the other products of higher boiling point, which no doubt contain *dibenzylethylchlorosilicane*, $SiEtBz_2Cl$, by fractional distillation; it is decomposed by water giving the corresponding silico-ketone, *benzylethylsilicone*, SiEtBzO, a colourless oil.

Benzylethylpropylchlorosilicane, SiEtPrBzCl, is obtained by the interaction of the preceding compound and magnesium propyl bromide; it boils at about 194—196° (100 mm.), but is not easily obtained in a state of purity. When decomposed with water, it gives two compounds, one of which, probably the *ether*, $(SiEtPrBz)_2O$, boils at about 255° (25 mm.); the principal product, however, is *benzylethylpropylsilicol*, $SiEtPrBz\cdot OH$, a colourless, mobile liquid which boils at about 155° (25 mm.).

This alcohol is readily sulphonated, giving apparently at least two sulphonic acids, one of which has been isolated in the form of its salts and found to be identical with the compound described above, which is obtained from the decomposition product of phenylbenzylethylpropylsilicane.

This fact seems to prove that the sulphonic acid in question is, as stated, a derivative of benzylethylpropylsilicol, but molecular weight determinations made with its ammonium salt indicate that polymerisation or condensation has occurred.

Benzylmethylethylpropylsilicane, SiMeEtPrBz, is formed when benzylethylpropylchlorosilicane is treated with magnesium methyl iodide; it is a mobile liquid boiling at about 250°.

The main object of this investigation being the preparation of an optically active compound containing an asymmetric silicon group (compare Kipping and Lloyd, *Trans.*, 1901, **79**, 449), most of the work described in this note is of a preliminary character, and the intermediate compounds have not yet been carefully examined.

23. "Photographic radiation of some mercury compounds." By Robert de Jersey Fleming-Struthers and James Ernest Marsh.

The mercury compound $HgC_2N_2,2(NH_2{\cdot}NH{\cdot}C_6H_5)$ was found to act on a photographic plate even through a sheet of paper in a few hours, forming a deep black patch on development. When a perforated sheet of zinc was enclosed between two pieces of paper and interposed, the action was exerted through the perforations and the substance of the paper. The position occupied by the perforations was dense black; the rest of the film was only slightly affected owing to an action of the metallic zinc.

This mercury compound also acted strongly at some distance from the plate, even through a layer of aluminium foil. Through a disc of quartz, there appeared at the first attempt a just perceptible darkening, but on repeating the experiment the result was negative.

The substance was placed over strong sulphuric acid to test for loss due to evaporation; this proved to be extremely small.

The generators of the compound were tested separately: the action of phenylhydrazine was more sluggish and diffused than that of the compound; the behaviour of mercuric cyanide was less definite, some specimens being active, others inactive; the active specimens lost their activity after heating. Mercuric cyanide was distilled in a high vacuum without decomposition; the distillate was inactive, even the most volatile portions. Inactive cyanide recovered its activity when slightly moistened with water; if covered with water, it was inactive.

Mercuric cyanide prepared from inactive mercuric oxide and hydrocyanic acid was active. Mercuric chloride was active, and retained its activity when distilled, both the distillate and residue being active. Mercuric bromide and mercuric and mercurous nitrates were active. Mercuric iodide, sulphate, acetate, sulphide, oxide, and mercuric ammonium chloride were inactive, or at the most very slightly active; as were also mercurous chloride, sulphate, acetate, and oxide. Redistilled metallic mercury had no action whatever on a gelatine dry plate; cuprous silver and potassium cyanides were also inactive.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

English Ceramic Society. Transactions, embracing papers and discussions for season 1903–4. pp. 115. ill. Longton 1905.

From the Society.

Ostwald, W. Conversations on chemistry. Authorised translation by Elizabeth Catherine Ramsay. Part I. General chemistry. First edition. pp. viii + 250. ill. London 1905. (*Recd.* 13/2/05.)

From the Publishers.

Sundbärg, Gustav. Sweden, its people and its industry. pp. xi + 1142. ill. Stockholm 1904. (*Recd.* 2/2/05.)

From the Swedish Government.

II. *By Purchase.*

Allen, Alfred H. Commercial organic analysis. A treatise on the properties, proximate analytical examination, and modes of assaying the various organic chemicals and products employed in the arts, manufactures, medicine, &c., with concise methods for the detection and determination of their impurities, adulterants, and products of decomposition. 3rd edition. Vol. 1. With revisions and addenda by the author and Henry Leffmann. Introduction, alcohols, neutral alcoholic derivatives, sugars, starch and its isomers, vegetable acids, &c. Vol. 2. With revisions and addenda by the author and Henry Leffmann. Part 1. Fixed oils, fats, waxes, glycerol, nitroglycerin, and nitroglycerin explosives. Part 2. Hydrocarbons, petroleum and coal-tar products, asphalt, phenols and creosotes. Vol. 3. Revised and edited by J. Merritt Matthews. Part 1. Tannins, dyes and colouring matters, writing inks. pp. xii + 557, x + 387, viii + 330, xii + 589. ill. London (printed in America) 1898—1901. (*Recd.* 10/2/05.)

Barnet book of photography. A collection of practical articles. pp. 287. ill. London 1903. (*Recd.* 10/2/05.)

Beck, Conrad, and Andrews, Herbert. Photographic lenses. 5th edition. pp. 270. ill. London [1903]. (*Recd.* 10/2/05.)

Brown, Adrian J. Laboratory studies for brewing students. A systematic course of practical work in the scientific principles underlying the processes of malting and brewing. pp. xviii + 193. ill. London 1904. (*Recd.* 10/2/05.)

Classen, A. Ausgewählte Methoden der analytischen Chemie. Unter

Mitwirkung von H. Cloeren. Band I. pp. xx + 940. ill. Braunschweig 1901. (*Recd.* 10/2/05.)

Cole, R. S. A treatise on photographic optics. pp. 330. ill. London 1899. (*Recd.* 10/2/05.)

Le Chatelier, H., and Boudouard, O. High-temperature measurements. Authorised translation and additions by G. K. Burgess. 2nd edition. pp. xv + 341. ill. New York 1904. (*Recd.* 10/2/05.)

Mitchell, C. Ainsworth, and Hepworth, T. C. Inks: their composition and manufacture, including methods of examination, and a full list of English patents. pp. xiv + 251. ill. London 1904. (*Recd* 10/2/05.)

Osmond, Floris, and Stead, J. E. Microscopic analysis of metals. pp. x + 178. ill. London 1904. (*Recd.* 10/2/05.)

Pringle, Andrew. Practical photo-micrography. pp. 179. ill. London 1902. (*Recd.* 10/2/05.)

Wall, E. J. The dictionary of photography. Revised and brought up to date by Thos. Bolas. 8th edition. pp. 656. ill. London 1902. (*Recd.* 10/2/05.)

Watts, W. Marshall. An introduction to the study of spectrum analysis. pp. vii + 325. ill. London 1904. (*Recd.* 10/2/05.)

III. *Pamphlets.*

Collins, S. H. Variation in the chemical composition of the swede (From the *J. of Agric. Science*, **1**, 1905.)

Feder, Erich. Beiträge zur Kenntnis der Basicität der Alkaloide, geprüft an ihrer Wirkung auf gewisse Oxydationsvorgänge. Strassburg 1904.

Hooper, David. Rusot: an ancient Eastern medicine. (From the *Journal, Asiatic Society of Bengal*, **73**, 1904.)

Jackson, A. H. Water softening. pp. 20. Melbourne 1904.

Sodeau, William H. Notes on some temperature regulators. (From the *J. Soc. Chem. Ind.*, **23**, 1904.)

Voorhees, Edward B. The use of fertilisers. A review of the results of experiments with nitrate of soda. (New Jersey Agric. Exper. Stations, Bulletin 172.)

Webster, C. S. Stanford. Luminescope for comparing substances under the influence of radium rays. (From the *J. Soc. Chem. Ind.*, **23**, 1904.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 29th, 1905** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets should be made not later than **Wednesday, March 22nd** next.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, addressed and made payable to the Assistant Secretary, Chemical Society, Burlington House, London, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and other business will be held on **Wednesday, March 29th, 1905**, at **half-past four** o'clock in the afternoon.

At the next Ordinary Meeting, on **Thursday**, March **2nd**, 1905, at **8** p.m., the following papers will be communicated:

"The latent heat of evaporation of benzene and some other compounds." By J. Campbell Brown.

"The relation between natural and synthetical glycerylphosphoric acids." By F. B. Power and F. Tutin.

"The reduction of *iso*phthalic acid." By W. H. Perkin, jun., and S. S. Pickles.

"The transmutation of geometrical isomerides." By A. W. Stewart.

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Issued 10/3/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 291.

Thursday, March 2nd, 1905. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. Robert J. Caldwell, Edward Evans, Lewis Eynon, and E. J. Fairhall were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

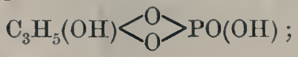
John George Baxter, Court Sole, Cliffe, Nr. Rochester, Kent.
Roger Dodds, Bigods Hall, Dunmow, Essex.
Sydney Dunstan, 107, Jesmond Road, Newcastle-on-Tyne.
Albert Gillies, Government Laboratories, Johannesburg, S. Africa.
Henry Isaac Gorman, 126, Quay, Waterford.
Ernest Green, 113, Hulton Street, Moss Side, Manchester.
John Hawthorne, 7, Roseneath Villas, Military Road, Cork.
Arthur Lonsdale Hetherington, B.A., Government Collegiate School, Rangoon, Burma.
Sydney A. Kay, D.Sc., 72, Market Street, St. Andrew's.
Leonard Gibbs Killby, B.A., 10, Aberdeen Park, Highbury, N.
Ernest Isaac Lewis, B.A., B.Sc., Felstead School, Felstead.
Alfons O'Farrelly, M.A., 3, Holles Street, Dublin.
William Sarginson, B.Sc., 200, Cauldon Road, Stoke-on-Trent.
Robert Reed Swann, B.Sc., The Agricultural College, Aspatria, Cumberland.

Of the following papers, those marked * were read :

*24. “The relation between natural and synthetical glycerylphosphoric acids.” By Frederick Belding Power and Frank Tutin.

Glycerylphosphoric acid was first prepared synthetically by Pelouze (*Compt. rend.*, 1845, **21**, 718, and *J. pr. Chem.*, 1845, **36**, 257), who, from the analyses of some of its salts, concluded that it was identical with that obtained from lecithin.

By the interaction of glycerol and phosphoric acid, it is possible that several esters may be formed, and three of these are now known, namely : the mono-ester, or glycerylphosphoric acid, $C_3H_5(OH)_2{\cdot}O{\cdot}PO(OH)_2$; the so-called di-ester,



$$C_3H_5(OH)<^{O}_{O}>PO(OH) ;$$

and the tri-ester, $C_3H_5{\vdots}PO_4$.

The authors have shown that the discrepancies of statement respecting the composition and characters of the salts of glycerylphosphoric acid (compare Portes and Prunier, *J. Pharm. Chim.*, 1894, **29**, 393 ; Petit and Polonowsky, *ibid.*, 1894, **30**, 193 ; and Adrian and Trillat, *ibid.*, 1898, **7**, 226) are due, as has been suggested by Carré (*Compt. rend.*, 1903, **137**, 1070), to their contamination with salts of the above-mentioned di-ester. It was therefore deemed of interest to ascertain the characters of the salts of glycerylphosphoric acid when prepared under such conditions as are known to exclude the formation of the di-ester, and a number of these have been described and analysed.

In the course of the authors' work, Willstätter and Lüdecke described an investigation (*Ber.*, 1904, **37**, 3753) in which they compared the barium and calcium salts of the natural and synthetical glycerylphosphoric acids, and came to the conclusion that the differences between them are not those which are usually observed in the case of optically active and racemic compounds. These differences consisted in the amount of metal contained in the respective salts, in the varying amounts of water believed to be retained by them when dried at certain temperatures, and in their relative solubility in water.

The authors have shown, however, that the conclusions of Willstätter and Lüdecke are not valid, inasmuch as their synthetical glycerylphosphoric acid was prepared under conditions which are known to afford some of the di-ester, and that the discrepancies they have observed are to a large extent due to the contamination of their salts of the synthetical acid with those of the di-ester rather than to the amount of water retained by them when subjected to heat.

The fact was also noted that the natural glycerylphosphoric acid has in no instance been prepared from a lecithin which was known to be a pure individual substance. Although the preparations obtained from this source by Willstätter and Lüdecke possessed optical activity, which proved the presence of the unsymmetrical acid, no evidence can as yet be adduced that they did not contain some of the symmetrical isomeride.

*25. "The transmutation of geometrical isomerides." By Alfred Walter Stewart.

In order to explain this series of phenomena, the author assumes as a phase of the reaction the formation and disruption of a tetramethylene compound. In the case of maleic and fumaric acids, the intermediate compound would be a tetramethylene-1 : 2 : 3 : 4-tetracarboxylic acid, in which, probably, the carboxyl groups attached to the 1 : 2-carbon atoms would lie on the side of the ring opposite to those attached to the 3 : 4-atoms. Such a tetramethylene ring might split up in two ways; either by breaking the linkings between 1 and 2, 3 and 4; or by breaking those joining 1 to 4 and 2 to 3. In the former case, fumaric acid is formed; in the latter, maleic acid is regenerated. If, however, fumaric acid is produced, owing to its higher melting point, it is immediately withdrawn from further action, while maleic acid is free to undergo the same series of changes. Fumaric acid, when distilled in presence of phosphoric oxide, is assumed to form the same type of tetramethylene derivative; but in this case water is abstracted from the carboxyl groups attached to the 1 : 2-carbon atoms, and also from those attached to the 3 : 4-atoms, the groups in each pair being in the *cis*-position to one another. Owing to the presence of the two anhydride chains, the tetramethylene ring cannot now break across in either of two ways, as in the last case, and consequently its disruption produces maleic anhydride. The complete series of changes:

$$\begin{tikzcd}
& \text{Fumaric acid} \arrow[dr] & \\
\text{Maleic acid} \arrow[ur] & & \text{Maleic anhydride} \arrow[ll] \arrow[dl, shift left] \\
& \text{Fumaryl chloride} \arrow[ur, shift left] &
\end{tikzcd}$$

can be thus explained; and also the transformations undergone by stereoisomeric oximes, hydrazones, and diazo-compounds. The author gives instances in which the tetramethylene intermediate product has actually been isolated, when it is found that its behaviour fulfils the conditions required by the hypothesis.

DISCUSSION.

Dr. COLMAN pointed out that tetramethylene-mono- and -dicarboxylic acids are very stable substances, and that it therefore hardly seemed probable that the tetramethylenetetracarboxylic acid, assumed by the author to be the intermediate product between fumaric acid and maleic anhydride, would be so readily resolved quantitatively into two molecules of maleic acid.

*26. "Linin." By James Stuart Hills and William Palmer Wynne.

According to Pagenstecher (*Buchner's Repert. Pharm.*, 1840, **72**, 311; 1842, **76**, 313; 1843, **79**, 216) and Schröder (*Neues Repert. Pharm.*, 1861, **10**, 11), purging flax (*Linum catharticum*), a small indigenous herb, contains a substance, linin, to which the former investigator attributed the purgative properties of the drug.

The authors believe the active principle to be a glucoside, which, however, has not been isolated in a pure state owing to its uncrystallisable nature. On hydrolysis with dilute acids or with lime, the glucoside is resolved into glucose and a substance which, so far as the comparison can be made, seems to be identical with Schröder's linin. The yield of crude linin amounts to about 0·13 per cent. by weight of the drug.

Linin, $C_{23}H_{24}O_9$ (mol. wt. 445 and 451 in naphthalene; 453 and 437 by the boiling point method in acetone), crystallises from alcohol in needles, and melts at about 203°, the exact melting point depending on the mode of heating; it is insoluble in water, sparingly soluble in the usual organic solvents, and gives a deep purple coloration with concentrated sulphuric acid. It contains four methoxyl groups, as determined by the Zeisel method; the demethylated derivative proved to be uncrystallisable. Attempts to prepare acetyl and benzoyl derivatives of linin were fruitless, and inconclusive results were obtained by fusion with caustic potash. Oxalic acid was the only recognisable product when it was oxidised with nitric acid or potassium permanganate under varied conditions. Linin is destitute of purgative properties.

*27. "The constitution of phenylmethylacridol." By James Johnston Dobbie and Charles Kenneth Tinkler.

When phenylacridine methiodide is treated with an alkali, a hydroxide is formed which was supposed at one time to be the base corresponding with the original salt. Hantzsch, however, from the results of conductivity experiments, concluded that it is really a carbinol formed by the shifting of the hydroxyl group from the nitrogen atom to an adjacent carbon atom at the moment of precipitation. Confirmation of this view is afforded by the fact that whilst the absorption spectra of phenylacridine methiodide and of the hydroxide derived from it differ widely, the spectra of the latter substance agree very closely with those of dihydrophenylacridine. This resemblance is inexplicable unless we regard the hydroxide as a carbinol bearing the same relation to dihydrophenylacridine that cotarnine bears to hydrocotarnine or hydrastinine to hydrohydrastinine (*Trans.*, 1903, **83**, 598; 1904, **85**, 1005).

28. "The ultra-violet absorption spectra of certain diazo-compounds in relation to their constitution." By James Johnston Dobbie and Charles Kenneth Tinkler.

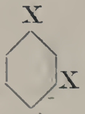
The authors have applied the spectroscopic method to the investigation of isomerism in the diazo-group. They find that the stable and unstable forms of the isomeric diazosulphonates and of the isomeric diazocyanides derived from *p*-anisidine and *p*-chloroaniline give identical spectra, or spectra agreeing more closely than those of any isomerides which differ structurally from one another. They regard this result as affording confirmation of the correctness of Hantzsch's view according to which these substances are *syn*- and *anti*-modifications, differing from one another in the same way as the *syn*- and *anti*-oximes. On the other hand, the isomeric potassium benzenediazotates, as also the two forms of the potassium compound obtained from diazotised sulphanilic acid, give widely different spectra. The spectra of the more stable (Schraube and Schmidt's) potassium benzenediazotate are almost identical with those of phenylmethylnitrosoamine, from which the authors infer that these compounds are constituted alike and are represented respectively by the formulæ $C_6H_5 \cdot NK \cdot NO$ and $C_6H_5 \cdot N(CH_3) \cdot NO$.

29. "The latent heat of evaporation of benzene and some other compounds." By James Campbell Brown.

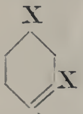
An improved apparatus has been employed in determining exactly the latent heat of benzene and its homologues. The latent heats of *tert.*-amyl alcohol and propyl *iso*butyrate are also recorded, together with Trouton's values (compare *Trans.*, 1903, **83**, 987).

30. "The reduction of *iso*phthalic acid" By William Henry Perkin, jun., and Samuel Shrowder Pickles.

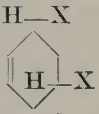
When *iso*phthalic acid is reduced with sodium amalgam at 45°, it yields two tetrahydro-acids (Δ^2 and *cis*-Δ^5), and, from these, two further acids are obtained by the methods mentioned below. Since there can only be four tetrahydro*iso*phthalic acids, namely :



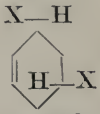
Δ^2.



Δ^3.



cis-Δ^5.



trans-Δ^5.

it follows that the authors have been successful in isolating all the possible modifications.

Δ^2-*Tetrahydro*iso*phthalic acid* melts at 168°, is very soluble in water, and is characterised by yielding a rather sparingly soluble calcium salt and an anhydride which melts at 78° ; it combines with hydrogen bromide and with bromine to form 2-bromohexahydro*iso*phthalic acid (m. p. 185—187°) and 2 :3-dibromohexahydro*iso*phthalic acid (m. p. 202°) respectively. When oxidised first with permanganate and then with chromic acid, it yields succinic acid.

Δ^3-*Tetrahydro*iso*phthalic acid* is produced when the other tetrahydro*iso*phthalic acids are boiled with strong caustic potash, intramolecular change taking place ; it melts at 244° and is very sparingly soluble in water. When it is digested with acetic anhydride and then distilled, it is converted into the anhydride of the Δ^2-acid. It combines with hydrogen bromide with difficulty, yielding a syrup which appears to be 4-bromohexahydro*iso*phthalic acid and readily absorbs bromine vapour with formation of 3 : 4-dibromohexahydro*iso*phthalic acid (m. p. about 230°). The latter acid is decomposed by boiling with caustic potash with formation of a dihydro*iso*phthalic acid which melts at 255° and is very sparingly soluble in water. When the Δ^3-tetrahydro-acid is oxidised with permanganate or with nitric acid, it yields *iso*phthalic and oxalic acids.

cis-Δ^5-*Tetrahydro*iso*phthalic acid* melts at about 165°, is very readily soluble in water and, when digested with acetic anhydride and distilled, yields the anhydride of the Δ^2-acid. It combines with bromine with formation of 5 : 6-dibromo-*cis*-hexahydro*iso*phthalic acid, which melts at about 220°.

trans-Δ^5-*Tetrahydro*iso*phthalic acid* is produced when the *cis*-acid is heated with hydrochloric acid at 170°. It melts at 225—227°, is very sparingly soluble in water, and combines with bromine to form 5 : 6-dibromo-*trans*-hexahydro*iso*phthalic acid, which decomposes at about 230—235°.

The reasons which have led the authors to assign to the various tetrahydro*iso*phthalic acids the constitutions given above are discussed in the detailed paper.

31. "The influence of temperature on the interaction between acetyl thiocyanate and certain bases. Thiocarbamides, including carboxy-aromatic groups." By the late Robert Elliott Doran (compiled by Augustus Edward Dixon).

Miquel's acetyl thiocyanate (*Ann. Chim. Phys.*, 1877, [v], **11**, 295), when brought into contact at low temperature with aniline dissolved in benzene, showed little sign of thiocarbimidic character, the principal change being the following double decomposition : $AcSCN + 2PhNH_2 = PhNH_2,HSCN + AcNHPh$. On the other hand, when these materials were caused to interact at higher temperatures, the thiocyanic character diminished and the thiocarbimidic reaction increased, until, in the neighbourhood of 85°, about 90 per cent. of the additive-compound (acetylphenylthiocarbamide) was obtained, according to the equation $AcNCS + PhNH_2 = AcNH{\cdot}CS{\cdot}NHPh$.

With *o*-toluidine this was not the case, an experiment conducted at 85° giving 91 per cent. of the available sulphur in the form of acetyl-*o*-tolylthiocarbamide, whilst at $-3°$ the yield of this substance was only a few per cent. less.

By combining acetyl thiocyanate with methylaniline in hot benzene, *acetylmethylphenylthiourea* was obtained in white crystals melting at 93—94°. *Acetylphenylbenzylthiourea* separated from dilute alcohol in fine, rhombic crystals melting at 110—111°. Piperidine gave no acetylpiperidylthiourea, but piperidylthiourea instead, together with piperidyl thiocyanate ; the former melted at 126—127°, the temperature given by Wallach (*Ber.*, 1899, **32**, 1872), and by treatment with acetic anhydride yielded the *acetyl* derivative, $AcN{:}C(SH){\cdot}NC_5H_{10}$ (long prisms, melting at 112—113°). By passing ammonia gas through a boiling solution of acetyl thiocyanate in benzene, 21 per cent. of the available sulphur was obtained as acetylthiourea, $AcN{:}C(SH){\cdot}NH_2$.

Phenyl chlorocarbonate, $PhO{\cdot}COCl$, when dissolved in benzene and left in contact with potassium thiocyanate until free from halogen, gave a solution of *carboxyphenylthiocarbimide*; by treatment with methylamine, this afforded *carboxyphenylmethylthiocarbamide*,

$$PhO{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NHMe$$

(long, glistening prisms melting at 175—176°), isomeric with the author's carboxymethylphenylthiocarbamide, $MeO{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NHPh$ (m. p. 158°) (*Trans.*, 1901, **79**, 908).

*Carboxyphenyl*iso*amylthiocarbamide* is a crystalline solid (m. p. 99—100°), isomeric with carboxy*iso*amylphenylthiocarbamide (*loc. cit.*, 914).

Phenylcarboxyphenylthiocarbamide, $PhO{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NHPh$, was obtained (*a*) from aniline, and (*b*) by expelling by means of phenyl chlorocarbonate the acetyl group from acetylphenylthiocarbamide; it melted at 148—149°.

Carboxyguaiacolphenylthiocarbamide,

$$MeO{\cdot}C_6H_4O{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}NHPh,$$

from guaiacol chlorocarbonate and acetylphenylthiocarbamide, melted at 154—155° and was freely desulphurised by warming with alkaline lead solution.

32. "The influence of solvents on the rotation of optically active compounds. Part VIII. Ethyl tartrate in chloroform." By Thomas Stewart Patterson.

Data relative to the rotation of ethyl tartrate in chloroform at various concentrations and temperatures are given. Chloroform has a marked effect in depressing the rotation of the ester. It is shown that the variation of rotation is in agreement with the change in solution-volume of the dissolved tartrate.

33. "A further note on the addition of sodium hydrogen sulphite to ketonic compounds." By Alfred Walter Stewart.

The author has applied the method already described (*Trans.*, 1905, **87**, 185) to some other compounds containing the carbonyl group.

The rate of addition of sodium hydrogen sulphite to ethyl acetoacetate having already been found to be much more rapid than was anticipated, it was thought advisable to try experiments with diethyl acetonedicarboxylate. The results were as follows:

After 10	20	30	40	50	60	70 minutes.
40·2	55·3	61·0	64·5	68·1	71·2	73 0

per cent. of bisulphite compound.

Comparing this with the numbers already found in the cases of acetone and ethyl acetoacetate, it appears that the replacement of hydrogen by a carboxyl group increases the velocity of addition, and when a second carboxyl group is introduced instead of another hydrogen atom, the velocity is further accelerated. This seemed to point to the addition of sodium hydrogen sulphite to the carboxyl group itself, but when this hypothesis was tested by determining the addition of sodium hydrogen sulphite to ethyl acetate, no interaction could be detected.

Diacetylacetone and acetonylacetone were also tried, one equivalent of sodium hydrogen sulphite solution for each carbonyl group present being used. The percentages for each carbonyl group were :

Bisulphite compound.	After 10	20	30	40	50	60	minutes.
Diacetylacetone...	14·6	17·8	21·3	23·9	26·3	27·8	per cent.
Acetonylacetone...	5·7	8·8	11·5	14·6	16·6	19·5	,,

Potassium β-camphorsulphonate, prepared by Reychler's method (*Bull. Soc. chim.*, 1898, [iii], **19**, 120), gave a constant value of 3·5 per cent.

The figures for maltose, glucose, and lactose are :

	After 10	20	30 minutes.	
Maltose ...	2·6	2·9	3·1	per cent. of bisulphite compound.
Glucose ...	5·2	5·2	5·2	,, ,,
Lactose ...	7·7	8·4	9·0	,, ,,

Unsuccessful attempts to prove the existence of additive products were made with epichlorohydrin, carbamide, acetamide, formamide, allyl alcohol, and ethyl cinnamate. Dimethylpyrone gave traces of some additive compound, but concordant results were not obtained.

34. "Action of hydrogen peroxide on carbohydrates in the presence of ferrous sulphate. Part V." By Robert Selby Morrell and Albert Ernest Bellars.

In this communication, attempts have been made to trace the disappearance of different sugars during their oxidation by observing the decrease in the rotation angle, and from the determination of the initial and final reducing powers of the solutions, as well as their acidities, to obtain a fuller knowledge of the many oxidation stages which occur. The results of the change in the optical activity show that during successive additions of hydrogen peroxide up to 1 gram-molecule for the same weight of carbohydrate, the decrease in the angle is proportional to the amount of oxidising agent added. The relative diminution in the angle depends on the sugar oxidised; galactose shows a greater decrease than glucose or fructose, maltose less than sucrose, which, in turn, has a smaller decrease than lactose. Rhamnose becomes lævorotatory on oxidation, and the rotation is practically constant after 2 gram-atoms of oxygen have been added. The high values of the final reducing powers must be due to the strong reducing powers of keto-acids and osones formed in the oxidation. The acidities of the solutions after oxidation are not large, and are insufficient to account even for the complete formation of one monobasic hexose acid.

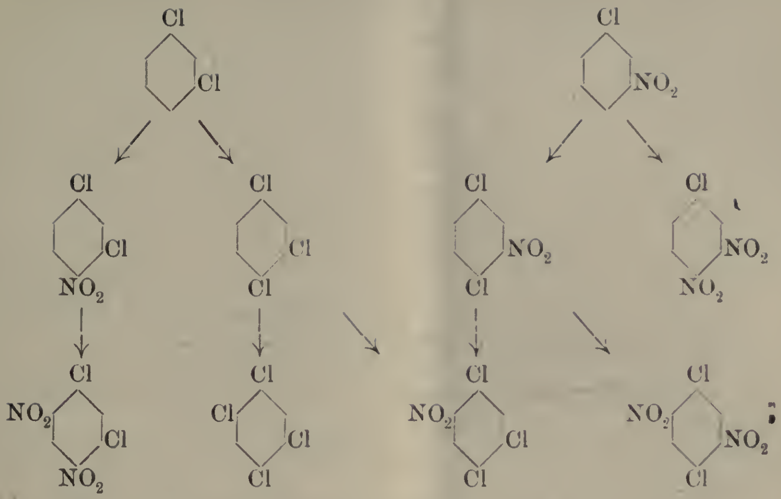
The smaller the yield of osazone precipitated by phenylhydrazine in the cold, the greater is the acidity of the solution. Attempts were made in the case of arabinose and rhamnose to isolate the acids formed during the oxidation. The simpler acids, formic and oxalic, were easily detected, but the more important keto-acids which were expected could not be isolated, although qualitative experiments leave little doubt as to their presence. Fischer's method (*Ber.*, 1902, **35**, 3141) has been applied to the formation of arabinosone from arabinose, rhamnosone from rhamnose, and by using *o*-nitrobenzaldehyde, glucosazone and rhamnosazone may be made to yield the corresponding osones.

Radium emanations were found to have no influence on the oxidation of fructose. When the conditions were arranged so that change in the concentration of the solutions became impossible, the optical activity of the sugar remained constant.

35. "Studies in chlorination. The chlorination of the isomeric chloronitrobenzenes." By Julius Berend Cohen and Hugh Garner Bennett.

In a recent paper by Cohen and Dakin (*Trans.*, 1904, **85**, 1274), attention was directed to the relation which was found to subsist between the position assumed by the third and fourth entrant chlorine atoms obtained by chlorinating *o*- and *p*-dichlorobenzenes and the six isomeric dichlorotoluenes, on the one hand, and those occupied by the two entrant nitro-groups on the other, and again by the fourth chlorine atom and nitro-group in the case of 1 : 2 : 4-trichlorobenzene and the six trichlorotoluenes.

The investigation has now been extended to the chlorination of *m*-dichlorobenzene and the mono- and di-chloronitrobenzenes. The results show remarkable conformity with the above rule, and no single exception has been recorded. It therefore follows that when the first two hydrogen atoms of benzene or toluene have been substituted by either two chlorine atoms or by one chlorine atom and one nitro-group, the positions occupied by subsequent chlorine atoms or nitro-groups are the same. The principal table of results is too long to reproduce, but that of the derivatives of *m*-dichloro- and *m*-chloro-nitrobenzenes will serve to illustrate the rule. The only secondary product recorded in this table is *p*-dichloro-*p*-dinitrobenzene. The remainder represent the sole products of each reaction :



ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 29th, 1905** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets should be made not later than **Wednesday, March 22nd** next.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, addressed and made payable to the Assistant Secretary, Chemical Society, Burlington House, London, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and other business will be held on **Wednesday, March 29th 1905**, at **half-past four** o'clock in the afternoon.

At the next Ordinary Meeting, on **Wednesday**, March **15th, 1905,** at **5.30** p.m., the following papers will be communicated :

"The velocity of oxime formation in certain ketones." By A. W. Stewart.

"Catechin and acacatechin. Supplementary note." By A. G. Perkin.

"The action of ethyl dibromopropanetetracarboxylate on the disodium compound of ethyl propanetetracarboxylate. A correction." By W. H. Perkin, jun.

"Glutaconic acid and the conversion of glutaric acid into trimethylenedicarboxylic acid." By G. Tattersall.

"The ultra-violet absorption spectra of certain enol-keto-tautomerides." By E. C. C. Baly and C. H. Desch.

"Esterification constants of substituted acrylic acids." By J. J. Sudborough and D. J. Roberts.

"α-Chlorocinnamic acids." By J. J. Sudborough and T. C. James.

"Di-ortho-substituted benzoic acids. Part VI. Conversion of methyl into ethyl esters." By J. J. Sudborough and T. H. Davies.

"A simple method for the estimation of acetyl groups." By J. J. Sudborough and W. Thomas.

"Gynocardin, a new cyanogenetic glucoside." By F. B. Power and F. H. Lees.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 27/3/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 292.

Wednesday, March 15th, 1905. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. A. G. Levy, F. L. Pyman, G. W. Monier-Williams, and W. H. Woodcock were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Frank Standish Findon, M.A., B.Sc., 41, Great Percy Street, Holford Square, W.C.
Edwin Morris, 12, Dragon View, Harrogate.
Frank Shedden, B.Sc., 5, Belvedere Road, Walsall.
George Devenish Thomas, B.Sc., 8, Hubert Terrace, Dover.

The President announced that Professor Percy Frankland had presented to the Society the eudiometer made and used by the late Sir Edward Frankland for the analysis of ethyl in 1849; that Professor Retzius, of Stockholm, had presented an engraving of Berzelius; and that Mr. Oscar Guttmann had presented a bronze medal struck in honour of Roger Bacon in Paris in 1818. The Council, on behalf of the Society, had expressed their thanks for these gifts.

Of the following papers, those marked * were read :

*36. "The velocity of oxime formation in certain ketones." By Alfred Walter Stewart.

With the object of gaining confirmation of the results already obtained in the case of the addition of sodium hydrogen sulphite to various ketones (this vol., p. 13), the author has investigated the rates of formation of the corresponding series of oximes. Solutions of the ketones were allowed to interact with a hydroxylamine sulphate solution for a fixed time, and the amount of free hydroxylamine was then estimated by warming with iodine solution and sodium phosphate and titrating with standard thiosulphate. The principal results are shown in the following table :

	After 10	20	30 minutes.
	Percentage of oxime.		
Acetone	45·1	49·7	50·0
Methyl ethyl ketone ...	36·6	39·2	39·2
Methyl *iso*propyl ketone	31·4	31·5	32·0
Pinacolin	12·9	17·0	24·5

The results are generally in agreement with those already found for the addition of sodium hydrogen sulphite to ketonic compounds, and since chemically the two reactions belong to different types, it seems probable that the hindrance to the reactions in the case of ketones containing many methyl groups near the carbonyl is due to stereochemical and not to purely chemical causes.

*37. "The ultra-violet absorption spectra of certain enol-keto-tautomerides. Part II." By Edward Charles Cyril Baly and Cecil Henry Desch.

In the first part of this investigation (*Trans.*, 1904, **85**, 1029), the ultra-violet absorption spectra of acetylacetone and ethyl acetoacetate and of certain of their derivatives were described. Evidence was then brought forward in support of the view that the absorption band exhibited by these substances is due to the equilibrium existing between the two possible tautomeric forms. Neither of the two modifications when in a pure state gives an absorption band, but when the two are present together in mutual equilibrium, that is to say, when a number of molecules are changing from one form into the other, a very decided absorption band is developed. The oscillation frequency of the light absorbed was further shown to be independent of the mass of the atom in the so-called labile condition.

The conclusions drawn in the first paper are now shown to be fully confirmed by an investigation into the absorption spectra of benzoylacetone, ethyl benzoylacetate, ethyl acetylsuccinate, ethyl diacetylsuccinate, ethyl oxaloacetate, ethyl acetonedicarboxylate, and ethyl benzoylsuccinate, together with certain of their derivatives. These results favour the view that the absorption band is due to the change of linking taking place when one tautomeric form passes into the other. It is possible to account for the formation of the absorption band by adopting the physical conception of the atoms as a system of electrons, and in this way the formation of the bands is placed in the same category as other spectral phenomena.

Some light is thrown on the dissociation of salts in solution by these results, and it appears probable that dissolved salts are not dissociated into independent ions, but that the two parts of the molecule are merely drawn apart to a certain extent by the action of the solvent. When the two parts are sufficiently separated to allow of the interchange of parts between adjacent molecules, then the condition known as ionisation exists. It is possible to have degrees of dissociation without any evidence such as is required by the electrolytic dissociation hypothesis; such degrees of dissociation no doubt occur in the case of organic compounds, which react apparently by means of ions, but the solutions of which present no evidences of the presence of the ions.

The aliphatic tautomeric compounds in solution present also a type of dissociation without the presence of ions. The labile atom is only drawn away from the rest of the molecule sufficiently to allow an interchange to occur between two different parts of the same molecule. The labile atom is a potential ion. Four grades of dissociation may be recognised.

DISCUSSION.

Sir W. RAMSAY remarked that the late Prof. Fitzgerald used to contend that the positive and negative ions could not be regarded as entirely independent entities, but must have some physical connection with each other. The "Faraday" tube spoken of by Mr. Baly may be taken as such a connection. If it be asked how far it is possible to stretch a "Faraday" tube, when one atom, positively charged, may be taken as independent of a negatively charged atom with which it was originally in union, the answer is that the atoms, formerly partners, may be separated by air, glass, or any material. Thus if an experiment suggested by Prof. Ostwald be conceived, in which the + and − ions of a solution of potassium chloride are present in different vessels, physicists would contend that the "Faraday" tube joining them would exist however far the ions be removed one from the other.

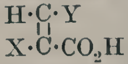
*38. "Esterification constants of substituted acrylic acids." By John Joseph Sudborough and David James Roberts.

The esterification constants of some 22 substituted acrylic and allied acids with methyl alcohol have been determined at 15°. The following compounds were examined: crotonic, cinnamic, *allo*cinnamic, β-chlorocrotonic, β-chloro*iso*crotonic, α-chlorocrotonic, methyl hydrogen fumarate, methyl hydrogen maleate, atropic, α-phenylcinnamic, α-phenyl*allo*cinnamic, α-bromocinnamic, α-bromo*allo*cinnamic, β-bromocinnamic, β-bromc*allo*cinnamic, α-chlorocinnamic, α-chloro*allo*cinnamic, β-chlorocinnamic, β-chloro*allo*cinnamic, furfurylacrylic, and *allo*furfurylacrylic, *n*-butyric, hydrocinnamic, and phenylpropiolic acids.

The results indicate that a substituted acrylic acid is esterified much less readily than the corresponding saturated acid, and somewhat more readily than the corresponding acetylenic acid,

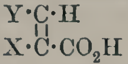
$$R\cdot CH_2\cdot CH_2\cdot CO_2H > R\cdot CH\vdots CH\cdot CO_2H > R\cdot C\vdots C\cdot CO_2H.$$

The effect of introducing substituents into acrylic acid is to lower the rate of esterification. This effect is the most marked when the substituent is in the α-position with respect to carboxyl. A comparison of the constants for pairs of stereoisomeric acids, for example,



$$\begin{array}{l} H\cdot C\cdot Y \\ \quad \| \\ X\cdot C\cdot CO_2H \end{array}$$

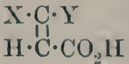
and



$$\begin{array}{l} Y\cdot C\cdot H \\ \quad \| \\ X\cdot C\cdot CO_2H \end{array},$$

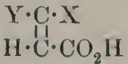
shows that the acid with CO_2H and Y in *cis*-position is esterified much less readily than when these substituents are in the *trans*-position. A similar relationship appears to hold good for pairs of acids, $Y\cdot CH\vdots CH\cdot CO_2H$, with the exception of cinnamic and *allo*cinnamic acids, which have exactly the same esterification constant.

No general relationships have been established hitherto between the pairs of acids,



$$\begin{array}{l} X\cdot C\cdot Y \\ \quad \| \\ H\cdot C\cdot CO_2H \end{array}$$

and



$$\begin{array}{l} Y\cdot C\cdot X \\ \quad \| \\ H\cdot C\cdot CO_2H \end{array}.$$

*39. "α-Chlorocinnamic acids." By John Joseph Sudborough and Thomas Campbell James.

The action of alkalis on cinnamic acid dichloride and its methyl ester has been studied. The product is a mixture of α-chloro- and α-chloro*allo*-cinnamic acids, and the relative amounts of the two vary but little with the temperature or with the alkali. Even when the acid dichloride is acted on at low temperatures, the amount of α-chloro-acid (m. p. 137°) is considerable, and is raised to only a very small extent by substituting the methyl ester for the acid dichloride. Cinnamic acid dichloride does not show the same tendency to eliminate carbon dioxide as was observed with the dibromide, and hence the amount of chlorocinnamene is practically nil unless the reaction proceeds at a high temperature.

The velocities with which α-bromo-, α-chloro-, α-bromo*allo*-, and α-chloro*allo*-cinnamic acids are acted on by aqueous potassium hydroxide have been determined.

The methyl ester, chloride, amide, anilide, *p*-toluidide, and α-naphthalide of the α-chloro-acid and the chloride and amide of the α-chloro-*allo*-acid have been prepared.

Phenylpropiolic acid may be prepared by heating the α-chloro-acid with 20 per cent. aqueous caustic potash (2·5 mols.) at 100° for 8 hours; the yield is about 50 per cent. of the theoretical amount, as carbon dioxide is evolved and an oil formed.

*40. "Diortho-substituted benzoic acid. Part VI. Conversion of methyl into ethyl esters." By John Joseph Sudborough and Thomas Huws Davies.

Purdie has shown that methyl esters of aliphatic acids are readily transformed into the corresponding ethyl esters by means of ethyl alcohol and a small amount of sodium or sodium ethoxide. The methyl esters of substituted benzoic acids can be transformed in a similar manner provided the two ortho-positions with respect to the carbmethoxy-group are not occupied. Thus, the methyl esters of *p*-nitro-, *m*-nitro-, 3 : 5-dinitro-, 3 : 5-dibromo-, 3 : 5-dibromo-4-amino-, and 3 : 4 : 5-tribromo-benzoic acids have been converted into the corresponding ethyl esters, and the ethyl esters of *m*-nitro-, *p*-nitro-, 3 : 5-dinitro-, *p*-bromo-, 3 : 5-dibromo-4-amino-, 3 : 4 : 5-tribromo-benzoic acids have been converted into the corresponding methyl esters by means of methyl alcohol and a small amount of sodium methoxide.

Methyl 2 : 6-dibromobenzoate, methyl 2 : 4 : 6-tribromobenzoate, methyl 2 : 4 : 6-trinitrobenzoate, and ethyl 2 : 4 : 6-tribromo-3-aminobenzoate could not be transformed in this way.

Discussion.

Dr. Cain said that he was rather of the opinion that in the *o*-substituted compounds described by the author a linking might occur between an oxygen and a bromine atom, the former becoming tetradic and the latter triadic, thus hindering or even altogether preventing the formation of an additive compound.

*41. "Simple method for the estimation of acetyl groups." By John Joseph Sudborough and Walter Thomas.

The acetyl derivative (0·5—1·0 gram) is added to a 10 per cent. solution of pure benzenesulphonic acid and the mixture subjected to steam distillation until the distillate is no longer acid. With *O*-acetyl derivatives, this usually takes 1—2 hours if the steam is passed through somewhat rapidly. The distillate is then neutralised by means of standard barium hydroxide, using phenolphthalein as indicator. Satisfactory results have been obtained with acetyl-α-naphthol, diacetylquinol, triacetylpyrogallol, hexa-acetylmannitol, and triacetylgallic acid.

N-Acetyl groups may be estimated in a similar manner, but the operation takes somewhat longer, especially in the case of mono- or di-acetyltribromoaniline, the retardation being due to the influence of the ortho-substituents. Good results have been obtained with acetanilide, mono- and di-aceto-*o*-toluidides, the corresponding *p*-compounds, diacetyl-ψ-cumidine, and the acetyl derivatives of α- and β-naphthylamines.

It is essential that the benzenesulphonic acid should be pure. The purification is readily accomplished by dissolving the barium salt in hot water, blowing steam through the solution until the distillate is neutral, allowing the barium salt to crystallise, and decomposing it with the theoretical amount of sulphuric acid.

Naphthalene-α- and -β-sulphonic acids may be used instead of the benzenesulphonic acid.

*42. "Gynocardin, a new cyanogenetic glucoside." By Frederick Belding Power and Frederic Herbert Lees.

The cyanogenetic glucoside, *gynocardin*, the isolation of which from the seeds of *Gynocardia odorata* (R. Br.) has previously been recorded (Power and Gornall, *Proc.*, 1904, **20**, 137), has now been further studied by the present authors.

Gynocardia seeds in contact with water afforded an amount of hydrogen cyanide equivalent to 0·44 per cent. of the entire seed or 0·63 per cent. of the kernels. The yield of crystalline glucoside was about 5 per cent. of the weight of the seeds.

Gynocardin separates from water in colourless, glistening, prismatic needles containing $1\frac{1}{2}H_2O$, which it loses at 115°. The anhydrous substance has the formula $C_{13}H_{19}O_9N$, melts at 162—163°, and has $[\alpha]_D^{21°} + 72·5°$ in aqueous solution.

Hepta-acetylgynocardin, $C_{13}H_{12}O_9(C_2H_3O)_7N$, forms needles melting at 118—119°, and having $[\alpha]_D + 40 \cdot 4^\circ$ in chloroform.

Gynocardin is readily hydrolysed at the ordinary temperature by *gynocardase*, the enzyme isolated from the seeds, but with difficulty by boiling 5 per cent. hydrochloric or sulphuric acid, according to the equation:

$$C_{13}H_{19}O_9N + H_2O = C_6H_{12}O_6 + C_6H_8O_4 + HCN.$$

Among the products of hydrolysis by either acids or the enzyme, it has been possible to isolate only *d*-glucose and hydrogen cyanide, the third substance, $C_6H_8O_4$, readily undergoing secondary decomposition with the formation of amorphous matter. By its comparatively great stability towards acid hydrolysing agents, gynocardin differs in a marked manner from the four other known members of its class (compare Dunstan and Henry, *Phil. Trans.*, 1901, **194**, 515; 1902, **199**, 399, and *Proc. Roy. Soc.*, 1903, **72**, 285).

Gynocardin is readily hydrolysed by barium hydroxide with the formation of crystalline *barium gynocardinate*, $(C_{12}H_{19}O_9 \cdot CO_2)_2Ba$, and ammonia, according to the equation:

$$C_{13}H_{19}O_9N + 2H_2O = C_{12}H_{19}O_9 \cdot CO_2H + NH_3.$$

Gynocardinic acid, $C_{12}H_{19}O_9 \cdot CO_2H$, forms a syrup which does not reduce Fehling's solution and is dextrorotatory; it is hydrolysed by acids in accordance with the equation:

$$C_{12}H_{19}O_9 \cdot CO_2H + H_2O = C_6H_{12}O_6 + C_7H_{10}O_6.$$

d-Glucose and an *acid* are thus formed. The latter could be isolated in the form of its *quinine* salt, $C_{20}H_{24}O_2N_2,C_7H_{10}O_6$, which crystallised in needles melting at 224° with decomposition. This salt, however, could only be separated in such small amount from the sugar which accompanied it that it has been impossible to determine the constitution of the acid $C_7H_{10}O_6$.

The foregoing results point, however, to the conclusion that gynocardin is the *d*-glucose ether of the cyanohydrin of either a trihydroxyaldehyde, $C_5H_4(OH)_3 \cdot CHO$, or a ketone, $C_5H_5(OH)_3 \colon CO$, respectively. In accordance with this view, the constitution of gynocardin can be represented by one of the following formulæ:

$$C_5H_4(OH)_3 \cdot CH(CN) \cdot O \cdot C_6H_{11}O_5 \text{ or } C_5H_5(OH)_3 \colon C(CN) \cdot O \cdot C_6H_{11}O_5.$$

Gynocardin is devoid of any appreciable physiological action.

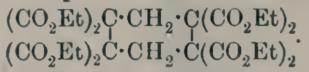
43. "Catechin and acacatechin. Supplementary note." By Arthur George Perkin.

As previously found, catechin (from Gambier catechu), when dried at 100°, melts at 175—177°, and Clauser's statement (*Ber.*, 1903, **36**, 101) that anhydrous catechin melts at 210° could not be substantiated.

Acacatechin, $C_{15}H_{14}O_6,3H_2O$, dried over sulphuric acid, loses $1H_2O$, and differs from catechin, $C_{15}H_{14}O_6,4H_2O$, which under these conditions evolves $3H_2O$. *Acacatechin tetramethyl ether* yields the acetyl compound, $C_{15}H_9O_6(CH_3)_4 \cdot C_2H_3O$ (colourless needles, m. p. 135—137°), and on oxidation with potassium permanganate gives *veratric acid* and another substance, which is probably *phloroglucinol dimethyl ether.* Catechin tetramethyl ether behaves similarly. With sulphuric or hydrochloric acid in the presence of acetic acid, catechin and acacatechin give an orange-red anhydride having the same composition in both cases ($C = 63{\cdot}26$; $H = 3{\cdot}89$; and $C = 63{\cdot}33$; $H = 3{\cdot}94$ respectively), which is insoluble in alkaline solutions and the usual solvents, but which is not identical with the "catechuretin" of Kraut and Delden (*Annalen*, 1863, **128**, 270) and Etti (*Annalen*, 1887, **186**, 332). When oxidised with potassium ferricyanide in the presence of an alkali acetate, both catechins yield a new colouring matter, which dyes mordanted fabrics in orange-brown shades.

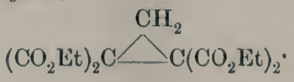
44. "The action of ethyl dibromopropanetetracarboxylate on the disodium derivative of ethyl propanetetracarboxylate. A correction." By William Henry Perkin, jun.

A short time ago (*Trans.*, 1903, **83**, 780), T. W. D. Gregory and the author published the results of a research on the above decomposition, and stated that the product of the reaction was *ethyl hexamethylene-octocarboxylate*,



$$\begin{array}{c}(CO_2Et)_2C\cdot CH_2\cdot C(CO_2Et)_2\\ | \qquad\qquad\quad |\\ (CO_2Et)_2C\cdot CH_2\cdot C(CO_2Et)_2\end{array}.$$

Dr. Max Guthzeit has called the attention of the present author to the fact that this interpretation is incorrect, and that the substance actually formed is *ethyl trimethylenetetracarboxylate*,



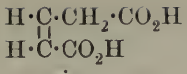
$$\begin{array}{c}CH_2\\ (CO_2Et)_2C \triangle C(CO_2Et)_2\end{array}.$$

The substances described by Gregory and Perkin as hexamethylene derivatives are therefore in reality trimethylene compounds.

This remarkable formation of the trimethylene ring is discussed in the detailed paper.

45. "Glutaconic acid and the conversion of glutaric acid into trimethylenedicarboxylic acid." By William Henry Perkin, jun., and George Tattersall.

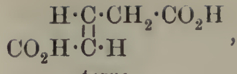
Glutaconic acid has hitherto only been obtained in one modification, although stereochemical theory indicates that the two modifications,



$$\begin{matrix}H\cdot C\cdot CH_2\cdot CO_2H\\ \|\\ H\cdot C\cdot CO_2H\end{matrix}$$

cis.

and



$$\begin{matrix}H\cdot C\cdot CH_2\cdot CO_2H\\ \|\\ CO_2H\cdot C\cdot H\end{matrix},$$

trans.

corresponding with fumaric and maleic acids, should exist.

Ordinary glutaconic acid (m. p. 134°) is the *cis*-modification, since it yields an anhydride which, under reduced pressure, distils without decomposition and on hydrolysis yields the same acid (compare Buchner, *Ber.*, 1890, **23**, 706).

The authors have been engaged in a series of investigations with the object of preparing the unknown or *trans*-modification of glutaconic acid, but without success.

When glutaconic acid is distilled, it decomposes partially into vinylacetic acid, $CH_2{:}CH\cdot CH_2\cdot CO_2H$, and carbon dioxide, but when heated with water at 180°, the decomposition takes place in another direction, and crotonic acid (m. p. 72°) results.

β-Hydroxyglutaric acid, $CO_2H\cdot CH_2\cdot CH(OH)\cdot CH_2\cdot CO_2H$, on distillation, yields a mixture of *cis*-glutaconic acid and its anhydride, and, when treated successively with phosphorus pentachloride and alcohol, it is converted into *ethyl β-chloroglutarate*,

$$CO_2Et\cdot CH_2\cdot CHCl\cdot CH_2\cdot CO_2Et,$$

which, when digested with diethylaniline and subsequently hydrolysed, regenerates *cis*-glutaconic acid.

Ethyl α-bromoglutarate, $CO_2Et\cdot CHBr\cdot CH_2\cdot CH_2\cdot CO_2Et$, is obtained from glutaric acid by bromination and subsequent esterification. When this ester is digested with diethylaniline and subsequently hydrolysed, or when simply hydrolysed with alcoholic potash, it yields *trans-trimethylenedicarboxylic acid* (m. p. 175°), $CH_2{<}\begin{matrix}CH\cdot CO_2H\\ |\\ CH\cdot CO_2H\end{matrix}$ (compare Bowtell and Perkin, *Proc.*, 1899, **15**, 241). Ethyl α-iodoglutarate, obtained from the bromo-ester by digesting with potassium iodide, behaves in exactly the same manner.

46. "The transformations of highly substituted nitroaminobenzenes." By Kennedy Joseph Previté Orton and Alice Emily Smith.

The *s*-trisubstituted nitroaminobenzenes do not undergo the isomeric change into nitroanilines characteristic of less substituted nitroaminobenzenes, since the ortho- and para-positions in the benzene nucleus relative to the amino-group are occupied. In some cases, for example, 1-nitroamino-*s*-tribromobenzene, a nitroaniline is produced by displacement of a bromine atom by the nitro-group under the same conditions in which the isomeric change is effected, namely, in acetic acid solution in the presence of sulphuric acid (*Trans.*, 1902, **81**, 490, 806). In other cases, a more complex decomposition takes place. For example, *s*-trichloronitroaminobenzene, which is obtained from *s*-trichloroaniline, yields *s*-trichlorobenzenediazonium salt, ammonia, and s-*trichlorophenylimino*-2 : 3 : 6-*trichlorobenzoquinone*, $C_6H_2Cl_3{\cdot}N{:}C_6HCl_3{:}O$, the two latter being in molecular proportions. The iminoquinone crystallises from petroleum in red crystals melting at 143°; on reduction, it is converted into 2 : 4 : 6 : 2′ : 3′ : 6′-*hexachloro*-4-*hydroxydiphenylamine*,

$$C_6H_2Cl_3{\cdot}NH{\cdot}C_6HCl_3{\cdot}OH,$$

which crystallises in long, colourless needles melting at 186°. When hydrolysed by sulphuric acid, the iminobenzoquinone is converted into molecular proportions of *s*-trichloroaniline and 2 : 3 : 6-trichlorobenzoquinone.

Since in all cases the acetic acid solutions of nitroaminobenzenes, on treatment with sulphuric acid, yield magenta, purple, or indigo-blue solutions from which are obtained on dilution nitroanilines or substituted phenyliminoquinones, according as the ortho- and para-positions with respect to the imino-group are occupied by other groups, it seems probable that analogous compounds, possibly quinone derivatives, are always present in these solutions; from these intermediary substances are produced, on the one hand, the nitroanilines, or, on the other, the iminoquinone derivatives.

47. "An asymmetric synthesis of quadrivalent sulphur." By Samuel Smiles.

The *l*-menthyl ester of methylethylthetine bromide was prepared from *l*-menthyl bromoacetate and methyl ethyl sulphide. It was found that (*a*) the product yields an inactive methylethylthetine on saponification with silver oxide or with cold concentrated hydrochloric acid; (*b*) that the molecular rotatory power of the product lies nearly halfway between those of the dimethyl and diethyl derivatives, and that this relation is also shown by the corresponding platinichlorides; (*c*) that the platinichloride of *dl*-methylethylthetine *l*-menthyl ester bromide, when prepared from *l*-menthol and the acid bromide of *dl*-methylethylthetine, has the same rotatory power as the platinichloride made from the product of asymmetric synthesis.

Hence it is concluded that the two isomeric *d*- and *l*-methylethylthetine *l*-menthyl ester bromides are produced in equal amount from the interaction of methyl ethyl sulphide and *l*-menthyl bromoacetate.

l-*Menthyl bromoacetate*, a colourless oil boiling at 144—145°/12 mm., has a sp. gr. 1·208 at 25°/4° and $[\alpha]_D^{25^\circ}$ $-61\cdot98^\circ$ and $[M]_D^{25^\circ}$ $-171\cdot68^\circ$; when dissolved in alcohol ($c = 12\cdot21$), $[\alpha]_D^{24^\circ}$ is $-62\cdot24^\circ$ and $[M]_D$ $-172\cdot4^\circ$.

Dimethylthetine l-*menthyl ester bromide*, $(CH_3)_2SBr\cdot CH_2\cdot CO_2\cdot C_{10}H_{19}$, melts at 87—90° with decomposition; in absolute alcohol, it has $[M]_D -157\cdot 9°$, and in 50 per cent. alcohol $[M]_D -162\cdot 7°$, and in acetone solution $[M]_D -159\cdot 2°$; the *chloride* has $[M]_D -162\cdot 0°$ approximately; the *hydroxide* is an oil which slowly decomposes into menthol and dimethylthetine. The *platinichloride* melts at 177° and in epichlorohydrin gives $[M]_D -371\cdot 3°$.

dl-*Methylethylthetine* l-*menthyl ester bromide*,

$$CH_3\cdot SBr(C_2H_5)\cdot CH_2\cdot CO_2\cdot C_{10}H_{19},$$

melts at 80—82° and in alcoholic solution has $[M]_D -162\cdot 7°$. Its *platinichloride* melts at 173—174° and has $[M]_D -351\cdot 0°$ in epichlorohydrin.

Diethylthetine l-*menthyl ester bromide*, $(C_2H_5)_2SBr\cdot CH_2\cdot CO_2\cdot C_{10}H_{19}$, melts at 73—74° and has $[M]_D -169\cdot 0°$ in alcoholic solution. The *platinichloride* melts at 148—149°, and a solution in epichlorohydrin gave $[M]_D -331\cdot 9°$.

48. "The action of α-halogen ketones on alkyl sulphides." By Samuel Smiles.

It has been found that certain α-halogen-substituted ketones interact with alkyl sulphides forming the halides of sulphine bases. The reaction is by no means general, for bromodiphenacyl,

$$C_6H_5\cdot CO\cdot CHBr\cdot CH_2\cdot CO\cdot C_6H_5,$$

α-bromocamphor, and certain other ketones do not act in this manner. Further, the activity of the bromine cannot be entirely due to the proximity of an acid radicle to the $CH_2\cdot Br$ group, for phenylbromomethylsulphone, $CH_2Br\cdot SO_2\cdot C_6H_5$, is without action on the alkyl sulphides. This behaviour of the α-halogen ketones is interesting when compared with that of the α-halogen-substituted acids which also contain the group $CH_2Br\cdot CO$, and react in a similar manner.

Monochloroacetone and methyl sulphide yield *acetonyldimethylsulphine chloride*, $(CH_3)_2SBr\cdot CH_2\cdot CO\cdot CH_3$, a colourless, uncrystallisable syrup which is very soluble in water; the *platinichloride* consists of pale yellow needles melting at 185°—186°.

ω-Bromoacetophenone and methyl sulphide unite to give a theoretical yield of *dimethylphenacylsulphine bromide*, $(CH_3)_2SBr\cdot CH_2\cdot CO\cdot C_6H_5$, which forms long, colourless needles, melting at 148°; it is soluble in hot water or alcohol, but very sparingly so in acetone. The *hydroxide* crystallises from chloroform in colourless leaflets which melt at 59—60°; it dissolves readily in water, giving strongly alkaline solutions. The *platinichloride* is thrown down from the aqueous solution of the chloride as a pale buff-coloured precipitate which, when pure, melts at 196—197° with decomposition. On mixing saturated alcoholic solutions of picric acid and the bromide, the *picrate* is precipitated in sparingly soluble needles (m. p. 151—152°). The *dichromate* is insoluble in water and melts at 168—169°.

Diethylphenacylsulphine bromide forms colourless needles (m. p. 88—89°) which are very soluble in water and alcohol, but sparingly so in acetone and ethyl acetate; the *platinichloride*, a pale buff-coloured powder insoluble in most organic media, melts at 146—147° with decomposition. The *picrate* crystallises from hot alcohol in the form of bright yellow needles and melts at 125—126°. *Diamylphenacylsulphine bromide* is a colourless, crystalline substance which is soluble in water or alcohol and melts at 60—61°; the *platinichloride*, melting at 138—139°, is soluble in warm ethyl acetate. Dimethyl sulphide and bromodeoxybenzoin give *dimethyldesylsulphine bromide*,

$$(CH_3)_2S\cdot CHBr(C_6H_5)\cdot CO\cdot C_6H_5\,;$$

this substance crystallises from warm ethyl acetate in colourless prisms which melt and decompose at 110°; the *platinichloride* dissolves in warm acetone and crystallises therefrom in buff-coloured needles which melt at 162°; the *picrate* forms yellow needles melting at 190°. (For other desyl derivatives, compare *Trans.*, 1900, **77**, 1178.)

49. "Pinene *iso*nitrosocyanide and its derivatives." By William Augustus Tilden and Harry Burrows.

A brief description of the cyanide and some of its reactions has been given in the "Preliminary notice of some new derivatives of pinene and other terpenes" by the same authors (*Proc.*, 1902, **18**, 161).

Pinene *iso*nitrosocyanide is shown to be a nitrile from which has been obtained, by the action of strong sulphuric acid, an amide of corresponding constitution. Pinene *iso*nitrosocarboxylamide,

$$C_{10}H_{15}(:NOH)\cdot CO\cdot NH_2,$$

forms prisms which melt at 220°. It yields a methyl ether, which forms large, colourless prisms melting at 145° and a benzoyl derivative melting at 197°.

Pinene *iso*nitrosocarboxylic acid, corresponding with the amide, has not been obtained, but hydrolysis with hydrochloric acid yields an oily acid volatile in steam, which is probably the ketonic acid,

$$O:C_{10}H_{15}\cdot CO_2H.$$

By the continued action of sulphuric acid on the amide, an isomeric change is induced, the product having the properties of the lactam in which the oxime group, $C:N\cdot OH$, has been converted into a carbonyl group, while an imino-group enters into the ring, thus: $-CO\cdot NH-$.

From this compound, by boiling with caustic potash, the corresponding acid has been obtained. The amide crystallises in prisms, which melt at 209° and contain 1 molecule of water of crystallisation. The acid also contains water of crystallisation and melts at 220°.

The silver and other salts of this acid have been prepared and analysed.

When heated with hydrochloric acid, the acid is converted into an amino-acid, which forms a stable, crystalline hydrochloride. In the formation of this compound, it is believed that the ring is opened and, by the assumption of the elements of water, the group $-CO\cdot NH-$ is converted into $-CO_2H$ and NH_2-.

50. "Some interactions of metallic cyanides with organic bases." By Robert de Jersey Fleming Struthers.

Phenylhydrazine heated with mercuric cyanide effervesces and deposits reduced mercury. This result might be indicated by the following obvious and simple equation: $HgC_2N_2 + C_6H_5\cdot NH\cdot NH_2 = Hg + 2HCN + N_2 + C_6H_6$, but in reality the reaction is complicated by the formation of the intermediate compound $HgC_2N_2,2C_6H_5\cdot NH\cdot NH_2$. This substance is a white, lustrous, crystalline solid sparingly soluble in water or alcohol; it melts and decomposes with effervescence at about 110° according to the equation: $3(HgC_2N_2,2C_6H_5\cdot NH\cdot NH_2) = 3Hg + 6HCN + 4N_2 + 4C_6H_6 + NH_3 + C_6H_5\cdot NH_2 + C_6H_5\cdot NH\cdot NH_2$.

Phenylhydrazine, when heated with cuprous cyanide, effervesces, but in other respects the action is different from that which obtains in the case of the mercury compound. An intermediate compound, $CuCN,C_6H_5\cdot NH\cdot NH_2$, was isolated in the form of brilliant scales with a silvery metallic lustre. This substance becomes rapidly discoloured at the ordinary temperature, evolves nitrogen, and ultimately acquires a deep coppery lustre. This evolution of gas was proved to be due not to spontaneous decomposition, but to an action of atmospheric oxygen.

When heated to a somewhat higher temperature than that required for the mercury salt, the copper derivative decomposes, thus: $2CuCN,C_6H_5\cdot NH\cdot NH_2 = 2CuCN + NH_3 + N_2 + C_6H_6 + C_6H_5\cdot NH_2$.

From the above reaction, it seemed possible that cuprous cyanide might exert a catalytic action on phenylhydrazine. This proved to be the case, quite a small quantity of the cyanide under proper conditions of temperature sufficing to liberate nearly the theoretical yield of nitrogen from a large excess of phenylhydrazine, the actual amount being some thirty times as much as would have been the case had there been no catalysis. The action is probably due to the alternate decomposition and regeneration of the compound $CuCN,C_6H_5\cdot NH\cdot NH_2$.

The cyanides of mercury, copper, and silver were also found to form definite additive compounds with pyridine, aniline, quinoline, and other similar bases.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Lewkowitsch, Julius. Chemische Technologie und Analyse der Öle, Fette und Wachse. 2 Bände. pp. xv + 458, x + 768. ill. Braunschweig 1905. (*Recd.* 16/2/05.) From the Author.

II. *By Purchase.*

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Porta, Giovanni Baptista. De distillatione libri IX. Quibus certa methodo, multipliciq́; artificio, penitioribus naturæ arcanis detectis, cuiuslibet mixti in propria elementa resolutio, perfectè docetur. pp. 154. ill. Rome 1608. (*Recd.* 7/3/05.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 29th, 1905** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

Tickets will be forwarded to Fellows on receipt of a remittance for the number required, addressed and made payable to the Assistant Secretary, Chemical Society, Burlington House, London, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the election of Officers and other business will be held on **Wednesday, March 29th, 1905**, at **half-past four** o'clock in the afternoon.

At the next Ordinary Meeting, on **Thursday**, April **6th**, 1905, at **8** p.m., the following papers will be communicated:

"The basic properties of oxygen at low temperatures. Additive compounds of the halogens with organic substances containing oxygen." By D. McIntosh.

"Note on the interaction of metallic cyanides and organic halides." By N. V. Sidgwick.

"The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds. Part II. Halogen substituted acetates." By A. Slator.

"The chemical kinetics of reactions with inverse reactions. The decomposition of dimethylcarbamide." By C. E. Fawsitt.

"The tautomerism of acetyl thiocyanate." By A. E. Dixon and J. Hawthorne.

"A method of determining the specific gravity of soluble salts by displacement in their own mother liquor, and its application in the case of the alkaline halides." By J. Y. Buchanan.

"The combination of mercaptans with unsaturated ketonic compounds." By S. Ruhemann.

"A new formation of acetylcamphor." By M. O. Forster and Miss H. M. Judd.

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Issued 14/4/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 293.

Wednesday, March 29th, 1905. Annual General Meeting. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Dr. A. E. H. TUTTON and Mr. A. G. BLOXAM were appointed Scrutators, and the Ballot was opened for the election of Officers and Council for the ensuing year. The President then presented the Report on the state of the Society during the past twelve months.

Mr. W. J. SELL moved the adoption of the Report; this was seconded, and carried unanimously.

REPORT OF THE COUNCIL.

THE Council are glad to be in the position to report that the Society continues to flourish, and that, as measured by the number of papers read, its activity has exceeded that of any previous year.

On December 31st, 1903, the number of Fellows was 2,700. During 1904, 128 Fellows were elected, and 5 reinstated, making a gross total of 2,833. The Society has lost 28 Fellows by death; 37 have resigned; the elections of 4 have become void; 52 have been removed for non-payment of subscriptions, and 1 Fellow has withdrawn. The total number of Fellows, therefore, on December 31st, 1904, was 2,711.

The names of the Fellows who have died are :

A. H. Allen.
F. E. Allhusen.
J. Barclay.
Sir I. L. Bell.
F. B. Benger.
C. Beringer.
H. N. Bilimoria.
W. Chattaway.
P. L. Dey.
T. H. Dodd.
W. H. Dodd.
R. E. Doran.
W. Francis.
A. Gibson.
C. G. Grenfell.
H. Grimshaw.
G. Howsam.
T. Isherwood.
J. Jackson.
A. Kitchin.
J. Mason.
D. Munro.
T. A. Pooley.
H. St. John.
C. J. Sawer.
W. H. Stanger.
R. M. W. Swan.
A. W. Williamson.

The following Fellows have resigned :

G. Ansdell.
J. F. Ballard.
J. Bardsley.
H. H. Barker.
G. E. Battle.
J. Baynes.
J. Bottomley.
G. W. Burman.
W. F. Butcher.
J. Caley.
H. M. Chapman.
T. A. Dickson.
E. Dowzard.
J. Edmunds.
T. A. Ellwood.
F. A. Gatty.
H. Gordon.
G. M. Gregory.
H. E. Haddon.
W. Hampton.
E. C. Ibbotson.
A. W. D. Leahy.
A. E. McKenzie.
T. R. Marshall.
W. Marshall.
C. A. Mitchell.
C. S. Purcell.
A. Sandford.
W. Sessions.
M. J. Sheridan.
W. Taverner.
G. Trench.
H. F. Waller.
A. W. Warrington.
A. L. White.
H. F. A. Wigley.
B. Winstone.

Among the Fellows removed by death, the Society mourns the loss of Prof. Alexander W. Williamson, who twice filled the office of President, and to whose initiative the publication of the *Abstracts* was largely due.

The number of Honorary and Foreign Members at the date of the last Annual General Meeting was 30. Six names were added to the list by the election on May 18th, 1904, of Prof. A. H. Becquerel, Prof. C. A. Lobry de Bruyn, Prof. F. W. Clarke, Madame M. Curie, Prof. C. Liebermann, and Prof. E. W. Morley. The Society has to lament the death of one of the newly elected Members, Prof. C. A. Lobry de Bruyn, on July 23rd, 1904. The number of Honorary and Foreign Members, therefore, is 35.

During the year 1904, 215 scientific communications have been made to the Society, 188 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of *Transactions* for 1904 contains 175 memoirs, occupying 1,761 pages, whilst that for the preceding year contains 142 memoirs, which occupy 1,490 pages.

The *Journal* for 1904 contains also 4,617 abstracts of papers published mainly in foreign journals, which extend to 1,920 pages, whilst the abstracts for 1903 numbered 3,882 and occupied 1,640 pages.

The abstracts for 1904 may be classified as follows:

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	1,072	1,968

Part II.

	Pages.	No. of Abstracts.
General and Physical Chemistry		606
Inorganic Chemistry.........................		541
Mineralogical Chemistry		132
Physiological Chemistry		501
Chemistry of Vegetable Physiology and Agriculture		311
Analytical Chemistry		558
	848	2,649
Total in Parts I. and II.	1,920	4,617

Owing to the great increase in the number of papers abstracted, it has become necessary to add to the editorial staff. Dr. C. H. Desch has been appointed Assistant Sub-editor, with the object of taking part in the preparation of abstracts for the press, and of relieving Mr. Greenaway of a portion of the clerical work.

Although an award of the Faraday Medal was made in 1895, fifteen years have elapsed since the delivery of the last Faraday Lecture. On April 19th, 1904, the Lecture was delivered by Professor Ostwald, in the lecture theatre of the Royal Institution, the use of which had been kindly granted by the Managers for the occasion. The subject of the Lecture was "Elements and Compounds."

The Wislicenus Memorial Lecture was delivered by Prof. W. H. Perkin on January 25th of the present year.

On the occasion of the celebration of the Jubilee of the Doctorate of

Sir Henry E. Roscoe, a Past President of the Society, on April 22nd, 1904, the Council welcomed the opportunity of sending an address of congratulation to him.

Proposals have been received from the Chemical, Metallurgical, and Mining Society of South Africa, and from the American Chemical Society, for a reciprocal exchange of Journals for members of each of these Societies and of the Chemical Society at a rate just sufficient to cover the cost of printing, addressing, and postage. After careful consideration, the Council were unable to accede to the proposals, as the effect on the finances of the Society could not be estimated, and a limit could not be set to the number of Societies which might seek the benefit of a similar exchange of Journals.

The question of co-operation in the preparation of Abstracts in English has been raised afresh by the American Chemical Society by the appointment of a committee to confer with the Chemical Society on this important subject. The Council have reappointed the Committee which discussed the possibility of co-operation in 1899, and await the proposals of the American Committee with every desire to consider their practicability.

Acting on the suggestion made in the Presidential address at the last Annual General Meeting, the Council have arranged for the preparation and publication of a series of Reports on the advance made each year in chemistry. These reports will be issued early in each year, and it is hoped that they will prove to be of value not only to the Fellows, but to students of chemistry generally.

Obituary notices of several deceased Past Presidents have not as yet been published. These notices have now been received and are in type. Among them is included an obituary notice of Sir Edward Frankland, as the Council have been unable to obtain the manuscript of the Memorial Lecture, delivered on October 31st, 1901.

A further increase in the use of the Library has to be recorded, 1,057 books being borrowed during 1904, as against 991 during the previous year. The additions to the Library comprise 119 books, of which 67 were presented, 296 volumes of periodicals, and 52 pamphlets, as against 126 books, 271 volumes of periodicals, and 43 pamphlets last year. An alteration in the wording of Library Rule IV. has been made to enable new books to be borrowed at an earlier date than formerly.

The Society has been the fortunate recipient of the eudiometer used by the late Sir Edward Frankland in the analysis of ethyl in 1849, presented by Professor Frankland; of a bronze medal of Roger Bacon, presented by Mr. Oscar Guttmann; and of an engraving of Berzelius, presented by Professor Retzius, of Stockholm.

A special Committee was appointed last June to revise the Bye-laws, and reported in due course to the Council. The revised Byelaws were submitted by the Council to the Society for consideration at an Extraordinary General Meeting on February 8th, but failed to secure acceptance, being referred back for further consideration.

A memorial, bearing the signatures of nineteen women engaged in chemical work, praying for the admission of women to the Fellowship of the Society, has been under consideration. The Council were advised that "married women are not eligible for election as Fellows of the Society; that it is extremely doubtful whether the Charter admits of the election of unmarried women as Fellows; that it would not be wise to elect even unmarried women without first applying for a supplemental Charter; and that the election of women as Associates would be legal after a modification of the Bye-laws expressly authorising their election." An alteration in Bye-law III. extending the privileges of the Associateship to women accordingly formed one of the changes in the Bye-laws recently proposed by the Council.

The third Report of the Joint International Committee on Atomic Weights, with its revised table of atomic weights, has been issued to the Fellows in the *Proceedings*.

Grants amounting in all to £215 have been made during the year from the Research Fund, and £26 16*s*. 6*d*. has been returned. Of the papers published in the *Transactions* during 1904, thirty-two were contributed by authors to whom grants had been made from the Research Fund.

The total income of the Society for the year 1904 was £6,700 5*s*. 8*d*. and the expenditure £5,982 14*s*. 6*d*.; in 1903, these were £6,817 19*s*. 7*d*. and £5,926 18*s*. 3*d*. respectively, so that whilst the income has fallen by £117 13*s*. 11*d*., the expenditure has risen by £55 16*s*. 3*d*. A glance at the balance sheet for 1903, however, shows receipts amounting to £257 which cannot be regarded truly as income from normal sources; in 1904 only £5 was so received. Allowing for these items, the income for 1904 shows an increase over that of 1903 of £134 6*s*. 1*d*.

The Treasurer's chief anxiety is due to the ever-increasing size of the *Journal* and the corresponding increase in cost. Both exceed those of 1903, the size by about 17 per cent. and the cost by about 10 per cent., the excess due to printing alone in 1904 amounting to £280 12*s*. 1*d*., whilst the total increase in cost reaches the large sum of £365 6*s*. 11*d*. Part of this is due to the fact that the January number for 1904 contained a double set of Abstracts, thus leading to an increase both in Abstractors' fees and in printing, these two items really representing thirteen months instead of twelve. As pointed out by the President on resigning the Treasurership two years ago, the steady increase in the size and cost of the *Journal* seems to render it inevitable "that, in the "near future, some more stringent regulations both as to the state of "the manuscript and the dimensions of the papers will have to be "imposed" if the Society is to carry on its work of publication efficiently. In addition to the cost of the *Journal*, there is in the present accounts a sum of £237 6*s*. 0*d*. for the printing of Vol. IV, Part 1 (Authors) of the Collective Index (1893—1902). On the other hand, there has been a saving of £42 14*s*. 5*d*. in the cost of the *Proceedings*. The Library has cost less by the sum of £150 13*s*. 3*d*., and the general administrative expenses, which in 1903 were abnormally high, owing to special circumstances, have fallen from £1,138 5*s*. 5*d*. to £893 1*s*. 0*d*., a saving of £245 4*s*. 5*d*., notwithstanding the cost of introducing house telephones and also connecting the Society with the Post Office system.

The Treasurer reports that the new system of keeping the Society's accounts has been in full working order for two years and has been found most satisfactory in every way.

The Council desire to place on record their appreciation of the valuable services rendered to the Society by Professor Wynne, and an expression of their regret that his removal from London obliges him to relinquish the office of Senior Secretary. By placing him among the Vice-Presidents, it is hoped that the Society may continue to receive the advantage of his experienced co-operation in the work of the Council.

The Treasurer made a statement as to the Society's income and expenditure during the past Session, and proposed a vote of thanks to the Auditors, which was seconded by Dr. L. T. Thorne, carried unanimously, and acknowledged by Mr. E. Grant Hooper.

The President then delivered his address, in which, after recapitulating the events connected with the Society which had occurred during the past year, he gave an exposition of his researches on the relation of specific heat to atomic weight in elements and compounds, the results of which led to the following conclusions.

1. The influence of temperature on the specific heats of many elements and compounds is much greater than was formerly supposed.

2. There appears to be no one condition or set of conditions under which the law of Dulong and Petit is true of all the elements.

3. The nearest approach to a constant available for practical purposes is found by taking the mean specific heats of metals between the freezing and boiling points of water, recognising glucinum, boron, carbon, and silicon as exceptions, together with hydrogen, oxygen, nitrogen, and perhaps chlorine in the solid form.

It is possible that the atomic heats of elements in the gaseous state may be equal, direct experiment on the gases having led to the value 2·4 for hydrogen, 2·5 to 2·7 for oxygen, and 2·6 for carbon (in carbon dioxide).

4. The independence of each atom in an element or compound must be regarded as a fact of the utmost importance from the point of view of theory. That the molecular heat of a compound is the sum of the atomic heats of all the elements present is in harmony with the results of observations on other additive properties, such as specific volume and specific refraction. Such independence suggests the idea that chemical combination results from the mechanical fitting together of atoms, so that a section through a mass would exhibit, if the atoms were visible, a certain tactical arrangement probably corresponding with the closest approximation possible under prevailing conditions. It has yet to be shown that chemical combination results, *in all cases*, from the existence of electric charges resident on the atoms or in electrons associated with them. The molecules of carbon compounds, especially, may be regarded as being probably formed by the adjustment of the constituent atoms to one another in respect to space, and it is noteworthy that the liquid binary compounds of carbon, the hydrides, chlorides, and oxides, are not electrolytes, and no case is known of the electro-deposition of carbon from such compounds in the elemental form.

Professor RAPHAEL MELDOLA proposed a vote of thanks to the President, coupled with the request that he would allow the Address to be printed in the *Transactions*. Professor G. CAREY FOSTER seconded the motion, which was carried by acclamation, and acknowledged by the President.

Professor H. McLEOD proposed a vote of thanks to the Treasurer, Secretaries, Foreign Secretary, and Council for their services during the past year. This was seconded by Dr. J. A. VOELCKER, and unanimously adopted. Professor W. P. WYNNE responded.

The Scrutators then presented their Report to the President, who declared the following to have been duly elected as Officers and Council for the ensuing year.

President: Raphael Meldola, F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir William Crookes, D.Sc., F.R.S.; Sir James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir

Henry E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents: Horace T. Brown, LL.D., F.R.S.; Harold B. Dixon, M.A., F.R.S.; Wyndham R. Dunstan, M.A., LL.D., F.R.S.; David Howard; A. Smithells, B.Sc., F.R.S.; W. P. Wynne, D.Sc., F.R.S.

Secretaries: M. O. Forster, D.Sc., Ph.D.; A. W. Crossley, D.Sc., Ph.D.

Foreign Secretary: Sir W. Ramsay, K.C.B., LL.D., F.R.S.

Treasurer: Alexander Scott, M.A., D.Sc., F.R.S.

Ordinary Members of Council: Edward C. C. Baly; Augustus E. Dixon, M.D.; J. J. Dobbie, M.A., D.Sc., F.R.S.; Bernard Dyer, D.Sc.; Alfred D. Hall, M.A.; A. Lapworth, D.Sc.; J. E. Marsh, M.A.; E. J. Mills, D.Sc., F.R.S.; G. T. Moody, D.Sc.; W. J. Sell, M.A., F.R.S.; J. M. Thomson, LL.D., F.R.S.; J. Wade, D.Sc.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society took place at the Whitehall Rooms on Wednesday, March 29th, at 7 p.m., when the following Fellows and their guests dined together:

Armit, Dr.
Attfield, Prof. J., F.R.S.
Beadle, Mr. C.
Beale, Mr. W. P., K.C.
Beilby, Mr. G.
Bevan, Mr. E. J., *President of the Society of Public Analysts.*
Bodmer, Mr. R.
Borns, Dr. H.
Bousfield, Dr. W., *Master of the Clothworkers' Company.*
Bowley, Mr. J. J.
Brown, Dr. H. T., F.R.S., *Vice-President.*
Browne, Sir J. Crichton-, F.R.S., *Treasurer of the Royal Institution.*
Callendar, Prof. H. L., F.R.S.
Cannon, Mr. M. J.
Carpmael, Mr. A.
Carr, Mr. S. E., *Assistant Secretary.*
Chapman, Mr. A. C.
Church, Sir W. S., Bart., K.C.B., *President of the Royal College of Physicians.*
Conrad, Mr. J. C.
Cottrill, Mr. F.
Cowley, Mr. G.
Crossley, Prof. A. W., *Hon. Secretary-elect.*
Daily Telegraph, The.
Dakin, Dr. H. D.
Day, Mr. A. B., *Master of the Society of Apothecaries.*
Dickins, Mr. F. V., C.B.
Divers, Prof. E., F.R.S., *Deputy-President of the Society of Chemical Industry.*
Dodds, Mr. J. M.
Dunstan, Prof. W. R., F.R.S., *Vice-President.*
Dyer, Dr. B.
Elliott, Sir T. H., K.C.B., *Secretary of the Board of Agriculture.*
Fairley, Mr. T.
Farmer, Prof. J. B., F.R.S.
Fenton, Mr. H. J. H., F.R.S.
Formoy, Mr. J. A.
Forster, Dr. M. O., *Hon. Secretary.*
Garwood, Prof. E. J.
Gibbons, Mr. W. M.
Glazebrook, Dr. R. T., F.R.S., *Director of the National Physical Laboratory.*
Gordon, Mr. J. G.
Gowland, Prof. W., F.S.A.
Greenaway, Mr. A. J., *Sub-Editor.*
Groves, Mr. C. E., F.R.S.
Guttmann, Mr. O.
Haggarth, Mr. R. N.
Haldane, The Rt. Hon. R. B., K.C., M.P.
Hall, Mr. S.
Harden, Dr. A.

Henry, Dr. T. A.
Hewitt, Dr. J. T.
Heycock, Mr. C. T., F.R.S.
Hicks, Dr. W. M., F.R.S., *Principal, University College, Sheffield.*
Hill, Mr. C. A.
Hills, Mr. J. S.
Hodgkinson, Prof. W. R.
Holloway, Mr. G. T.
Hooper, Mr. E. G.
Howard, Mr. T.
Jackson, Mr. H.
Johnston, Mr. J. H.
Jones, Dr. H. O.
Jones, Mr. O. T.
Judd, Prof. J. W., C.B., F.R.S., *Dean of the Royal College of Science.*
Kemp, Mr. W. J.
Knowles, Mr. J.
Kohn, Dr. C. A.
Larmor, Prof. J., F.R.S., *Secretary of the Royal Society.*
Leah, Mr. S. D , I.S.O.
Lewkowitsch, Dr. J.
Lockyer, Sir J. Norman, K.C.B., F.R.S., *Director of the Solar Physics Observatory.*
Lowry, Dr. T. M.
Lynn, Mr. A.
MacEwan, Mr. P.
Mason, Mr. H.
Matthews, Dr. F. E.
Meldola, Prof. R., F.R.S., *President-elect.*
Messel, Dr. R.
Millington, Mr. J. P.
Mills, Mr. J. P.
Mohr, Dr. B.
Mond, Mr. E. S.
Mondy, Mr. E. F.
Moody, Dr. G. T.
Moore, Mr. J. E. S.
Morgan, Dr. G. T., *Editor.*
Morning Post, The.
Morrell, Dr. R. S.
Moss, Mr. C. C. B.
Müller, Dr. H., F.R.S., *Past President.*
Newth, Mr. G. S.
Newton, Mr. A. W.
Ogilvie, Mr. F. G., *Principal Assistant-Secretary, Technology and Higher Education in Science and Art, Board of Education.*
Orton, Prof. K. J. P.
Page, Mr. F. J. M.
Pam, Mr. A.
Penton, Col. A. P., R.A., C.B.
Perkin, Dr. W. H , F.R.S., *Past President.*
Perry, Prof. J., F.R.S.
Philip, Dr. J. C.
Ping, Mr. W.
Power, Dr. F. B.
Preece, Mr. A., C.E.
Press Association, The.
Pye-Smith, Dr. P. H., F.R.S., *Vice-Chancellor of the University of London.*
Ramsay, Sir W., K.C.B., F.R.S., *Foreign Secretary.*
Rastab, Mr. R. H.
Rayleigh, The Rt. Hon. Lord, O.M., F.R.S.
Reynolds, Prof. J. E., F.R.S., *Past President.*
Robinson, Mr. R. A., *President of the Pharmaceutical Society.*
Scott, Dr. A., F.R.S., *Treasurer.*
Sell, Mr. W. J., F.R.S.
Spielmann, Mr. P. E.
Standard, The.
Stevenson, Mr. H. E.
Stevenson, Mr J.
Sueur, Dr. H. R. Le.
Swinburne, Mr. J.
Teed, Dr. F. L.
Thomson, Prof. J. M., F.R.S.
Thorne, Dr. L. T.
Thorpe, Dr. J. F.
Thorpe, Prof. T. E., C.B., F.R.S., *Past President.*
Thorpe, Mr. W. B.
Tilden, Prof. W. A., V.P.R.S., *President.*
Tilley, Mr. J. W.
Tilley, Mr. V. J.
Times, The.
Tunnicliffe, Mr. J. E.
Tyrer, Mr. T.
Voelcker, Dr. J. A.
Wade, Dr. J.
Watt, Sir George, C.I.E.
Webb, Sir Aston. R.A.
Wrampelmeier, Mr. T. J.
Wynne, Prof. W. P., F.R.S., *Hon. Secretary and Vice-President-elect.*
Young, Mr. A.

The following Toasts were proposed :—

By The President.

1. His Most Gracious Majesty the King.
2. Her Majesty the Queen Alexandra, their Royal Highnesses the Prince and Princess of Wales, and the other Members of the Royal Family.

By Sir William S. Church, Bart., K.C.B.,

President of the Royal College of Physicians.

3. Prosperity to the Chemical Society, coupled with the name of *The President*

By Professor Raphael Meldola, F.R.S.,

President-Elect of the Chemical Society.

4. Scientific Institutions, coupled with the names of Professor Joseph Larmor, D.Sc., F.R.S., *Secretary of the Royal Society*, and Dr. R. T. Glazebrook, F.R.S., *Director of the National Physical Laboratory.*

By Sir William Ramsay, K.C.B., LL.D., F.R.S.,

Foreign Secretary of the Chemical Society.

5. The Guests, coupled with the names of The Right Honourable R. B. Haldane, K.C., M.P., and Professor John Perry, D.Sc., F.R.S.

The President, in proposing the toast of "His Most Gracious Majesty the King," said he did not intend to question the loyalty and the good sense of the Fellows of the Chemical Society and their guests by making a speech.

The toast was drunk with enthusiasm.

The President next proposed the toast of "Her Majesty the Queen Alexandra, their Royal Highnesses the Prince and Princess of Wales, and the other members of the Royal Family." No words, he said, were necessary to recommend the toast, but it would be appropriate to say on that occasion that they had all watched with interest the progress of the voyage undertaken by Her Majesty and her Royal daughters, and they trusted that they would return in due time from the sunny seas of the South refreshed and invigorated by the sea breezes.

The toast having been duly honoured,

Sir William S. Church, K.C.B., in proposing the toast of "Prosperity to the Chemical Society," said he did not know what may have been passing in the President's mind at the time when he (the speaker) was thought to be a fit person to propose the toast. It may have been that the President's memory went back to the time when few, excepting those of the medical profession, had any acquaintance with the chemistry of their day, and when few took any interest in the study of the phenomena of nature. When they looked round that assembly there could be no doubt of the position chemistry had taken in these days. That Society was one of the oldest of the Societies in the Kingdom, dealing with different branches of science. It was founded more than sixty years ago—in 1841—and as long ago as 1848 it received its charter. Just consider what had taken place since those days. At that time the Society numbered only 300 members. He did not know the present numbers, but what he did know was that the advances made in Chemical Science and the advantages to the world derived therefrom could not possibly be over-estimated. In that advance their Society had played a very large and prominent part. When one considered the extraordinary advance of knowledge which had taken place since 1841—and how the science of chemistry was now connected and inter-connected with all the ordinary necessaries of life, it was remarkable to consider the difference between the position of Chemical Science in this country in 1841 and to-day. Out of their Society—which had for its object the advancement and the distribution of knowledge, and the publication of special researches in its own branch of science—had grown other societies—those which dealt with the application of chemistry to the arts and necessaries of life. The principal societies were the Society of Chemical Industry, the Institute of Chemistry, the Society of Public Analysts, and the Pharmaceutical Society. He did not know whether their Society had any titular god or goddess upon its sigillum or seal, but it must have been a difficult matter to make a choice, because they might have chosen Ceres as illustrating the peace and prosperity which had accrued to the country through the advances of chemistry; or, on the other hand, he feared they could equally have chosen Bellona when they considered how much chemistry had done in the promotion of arms. But neither of these objects had been the aim of their Society. Its true object had been the advancement of knowledge by searching out the forces and secrets of nature. What higher aim could a Society have? In those few words he gave them the toast of Prosperity to the Chemical Society.

The PRESIDENT, in replying, said he hoped they would agree with him that it was quite a proper thing to do to invite Sir Wm. Church, President of the Royal College of Physicians, to propose the toast, remembering that if chemistry did not spring entirely out of medicine, at any rate, the two branches of applied science had always been closely associated in the past. He was glad Sir William Church reminded them of the very important principle that experiment was the most secure basis of progress in all natural knowledge, which he thought was not always borne in mind by all his chemical friends. Some of them were ready to invent new hypotheses for explaining everything that occurred day by day, forgetting that every hypothesis, no matter how attractive, would sooner or later be superseded by something more comprehensive, based upon fresh knowledge. They had the honour of entertaining that evening one of the most brilliant exponents of the application of that principle—of course, he need scarcely say he referred to Lord Rayleigh. Experiment was the best foundation—and he was looking to his friend, Sir Wm. Ramsay, to fully agree with him.

Dr. Johnson once said that when a man knew he was going to be hanged in a fortnight, it tended greatly to concentrate his thoughts. They would, therefore, readily understand his own position during the past fortnight. That festival was the occasion of what might be called the apotheosis of the retiring President. He should wake up in the morning to find that he was no longer President of the Chemical Society, but one that had been President, and no matter what might happen in years to come, that great source of pride and satisfaction could not be taken from him. Many other changes also came about at the same time, and he could not help referring again with great regret to the change which deprived them of the help and the association of their friend Professor Wynne, the Senior Secretary. The Society owed a great deal to its officers, and especially to the Secretaries, and in welcoming Professor Crossley to fill the vacant post, they might feel confident that the share of the Society's affairs which fell to his lot would not suffer at his hands. The Society had now passed its first youth, having celebrated its Jubilee fourteen years ago. Of course, as Sir William Church had reminded them, many changes had taken place, not only in the extent of their knowledge but in the fundamental nature of their ideas with regard to all chemical questions since the foundation of the Society. Occasions like that must revive very vividly in the minds of some of the past presidents—several of whom he saw present that evening—the successive changes that had gone on since they held office. In the past year they had lost, in the person of the late Professor Williamson, a past president, one of those great men who had helped to lay the foundations of their science and of whom so few now remained. The Chemical Society had grown rapidly, but more particularly during the last ten or twelve years. He had been an officer of the Society for six years, and even in his time the membership had increased, roughly, about 100 per annum. When they entered upon the occupancy of the rooms which were allotted to them by the Government in Burlington House, the members in their ranks did not exceed about one-third of what they were now. That was thirty years ago. But now they were beginning to feel like some of those crustaceans, who periodically found their shells too tight. They wriggled out of it somehow and then grew a new shell better fitted to their enlarged proportions. They were not yet in a position to do that, but certainly the Society began to find its present quarters rather a tight fit. It seemed to him that a few informal gatherings for conversation, sometimes, perhaps, for demonstration and experiment, would be of great advantage to them; but he confessed he had never been able to see how it could be accomplished in their present quarters; and he could not help feeling some sentiment of envy toward their friends, the German Chemical Society, who occupied the palatial Hofmann-Haus in Berlin. They could hardly hope yet to secure quarters comparable with those. Nevertheless, the idea was fixed in his mind that informal gatherings might be useful in removing misunderstandings that sometimes would exist —notwithstanding the efforts of the Council and the Publication Committee—such as arose when authors of papers were not satisfied with the number of pages assigned to their important contributions. Questions of that kind arose, and occasioned now and then little heart-burnings—not very much—but even that little could probably be removed if they had opportunities of meeting together to talk—and to smoke, if they liked—and of getting to understand and to know one another rather better. The Fellows of the Chemical Society could really not be reproached for indulging too freely in conviviality. They dined only once in two years—and he was told that some of them drank beer after the ordinary scientific meetings—which, no doubt, occasionally were conducive to thirst.. He was confident that the Society would continue to grow and prosper. It was necessary that it should grow, if they were to continue the development and publication of their splendid Journal. He would say fearlessly that their Journal—

if not in bulk, certainly in quality, was equal to any scientific journal in the world—and it did, at the present time, fairly represent British chemistry. Of course, they must all go on reading French and German, but he wished some of their friends on the Continent could be induced to learn to read English—and the only way to compel them to do so was to make the JOURNAL so good that they could not afford to ignore it. All this could only be accomplished by their sticking together, by doing their scientific best, and pouring into the JOURNAL all the products of their laboratories and experimental work.

PROFESSOR RAPHAEL MELDOLA, F.R.S., proposed "Scientific Institutions." Looking at the list of institutions represented there that evening, he said, it might be confidently asserted that every one of the subjects represented by those institutions came well within the cognisance of the Fellows of the Chemical Society; and he supposed there was no branch of natural knowledge at the present time into which chemistry had not, in one way or another, inserted itself. They welcomed all co-workers in their domain. There were representatives of institutions other than those that had been mentioned, and he hoped Sir Thomas Elliott would allow the Board of Agriculture to be considered a scientific institution. Chemistry had certainly made itself felt in that department. They welcomed Professor Larmor, not only on behalf of the Society which he represented, but in his individual capacity. The great specialisation of science in modern times had taken away a great many of the communications which the Royal Society used to receive. This in no way detracted from the status or the importance of the Royal Society, but it rather spoke in favour of the active development of modern science in various directions. Professor Larmor's name stood pre-eminent in the great work of chemical science, although with regard to his own work, he (Professor Meldola) was afraid he must confess that he and many of his colleagues were not able to follow the Professor in all his abstruse flights. With regard to Dr. Glazebrook, they all knew that although a comparatively young institution, the National Physical Laboratory had amply justified its foundation. He need hardly remind those present that any institution which helped them to standardise the instruments they used, conferred an inestimable benefit upon their science and upon the work they were undertaking. Moreover, judging from a recent report of the National Physical Laboratory, much work had been done lately which might legitimately be classified as more or less chemical in character, and in welcoming the Director of that Laboratory they could only express their satisfaction that the results which had been achieved had been achieved with comparatively modest means, when they considered that the Government aid to the National Physical Laboratory was about one-fourth that given to the Reichsanstalt at Berlin, and one-fifth that given to the Bureau of Standards for the United States. In conclusion, he paid a tribute to the work of Sir Norman Lockyer, Lord Rayleigh, and Sir William Ramsay.

PROFESSOR JOSEPH LARMOR, in replying, said he was glad to be greeted as an official of the parent Society, which had preserved the closest possible relations with her offspring. He believed that in this country there was a notion that much more could be achieved by the scientific workers here than in any other country in the world. Continental nations gave very extensive subsidies from public money, whereas in England it was considered that scientific men should provide their own means.

DR. R. T. GLAZEBROOK also responded. He said his Institution had a large field to cover, and at each point of that field they were brought into close contact with other Societies. They claimed to be a kindred institution because they had the same high aims and employed exactly the same experimental methods as those pursued by the Chemical Society. He was glad to bear witness to the great assistance given them by their chemical friends, and the impossibility of conducting much of that work without that assistance, so cordially and generously given.

SIR WILLIAM RAMSAY, K.C.B., next proposed "The Guests." He said he would not be so invidious as to allude to their guests by name or qualification. These details could all be found in the "Dictionary of National Biography" or in the more modest "Who's Who." They were delighted to see their friends and guests present, and hoped to see them all again on many similar occasions.

The RT. HON. R. B. HALDANE, in responding, said he objected to be divided by a line, as Sir William Ramsay had done, from Professor Perry. If Professor Perry could, as Sir John Fisher once said, teach the differential calculus to the working classes, he (Mr. Haldane) had ventured to teach equally dubious things to the working classes. He could not call himself a chemist, but he had got a conviction that the problem which lay in front of the British nation was how to develop what he might call the grey matter of the executive brain. All the things spoken of that night represented something new in the nation, and not only something new, but something of which they would have to see a great deal more if the nation was to hold its own in these days. Science counted for more than ever it did. The West had had a rude awakening at the hands of the East. The controversies which agitated the minds of politicians were of less importance than the great question of how to make the permanent element in politics more powerful and better than it was. He was not talking of Cabinets. They come and go, but to-day they seem to go more rapidly than ever. There was too little science in the present day, although one or two things had been done for which they were very grateful, in connection with the Navy and the Army and the Defence Committee. That was one link. If they turned to the different departments of the Government there was hardly one which did not require science, if its policy was to be an effective policy. The War Office and the Admiralty were dependent on the higher problems at the command of science. The Department of Public Health—the Local Government Board—was in the same position, and so was the Board of Trade, which brought another kind of science—that science which could only come from a very wide survey from the largest point of view of the dull subject of statistics. Wherever they turned science was needed, and yet there was not sufficient attraction to a man of high attainments to put himself at the disposition of the State. Foreign Governments held out careers far in excess of any rewards and honours which the British Government could afford. Was it impossible to see an era in which the head of the Government could have at his disposition the first intelligence and the best brains which the nation could command? While that might be a dream, it was, he thought, a dream which events were preparing them for seeing realised. If we were to hold our own we must not be behind Berlin, the United States, or the French nation. There was a policy more worthy the consideration of politicians than some policies which were taking up the time of the House of Commons, and this policy had the great advantage that it was a non-party one. He looked forward to the day when somebody would put his back into this business, that somebody would have the power of so impelling the administration of the day that it would be forced to respond to the demand of every class of the electorate, and every section of British society. Anybody who wished to attract public confidence could do worse than take up a policy of that kind, and he believed the British Treasury would open its hand. Science never stands still, and if science does not stand still, Governments cannot afford to stand still in their use of science. These were speculations which, perhaps, went beyond the moment, but he had a strong feeling that the time was very nearly, if not quite, ripe for them. They would see what was the mind of the nation on this point, and doubtless they would be subjected to the acute disappointment to which all were usually subjected when they formed great expectations. He hoped to see the position of science raised in the next few years, and he looked to the time when brute force would count for little, and knowledge for more.

PROFESSOR PERRY also responded.

Thursday, April 6th, 1905. Professor R. MELDOLA, F.R.S., President, in the Chair.

It was proposed by Professor ARMSTRONG and seconded by Dr. LAPWORTH that the minutes of the previous meeting be taken as read. After some discussion, the President ruled that the course prescribed in Bye-law XI be followed.

Messrs. B. M. Jones, C. E. Fawsitt, A. Angel, and W. H. Ratcliffe were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Albert Edward Andrews, 37, Oakhurst Grove, East Dulwich, S.E.
Francis George Belton, 16, Clarkson Street, Sheffield.
Edward S. H. E. Brettell-Vaughan, The Cwm, Aston-on-Clun, Salop.
Thomas Walter Firth Clark, 117, Clerkenwell Road, E.C.
Horace Finnemore, 21, Linden Mansions, Highgate, N.
John Griffiths, B.Sc., The Hollies, Upton Park, Chester.
James Henry Howgate, B.A., The Avenue, Bakewell, Derbyshire.
William Henry Leek, B.A., Elm View, Leigh, Lancashire.
Francis Grimshaw Martin, King Henry VIII School, Coventry.
Alfred Mortimer, B.A., Trinity College, Stratford-on-Avon.
Sydney Dockeray Stennitt, M.Sc., 16, Richmond Terrace, Whitchurch, Salop.
Edmund Henry Stevens, B.A., Haw House, Rothbury, Northumberland.
Harold Blythen Stevens, 225, Oxford Street, W.
Francis Henry Wall, 14, Hardman Street, Liverpool.

Of the following papers, those marked * were read :

51*. "The kinetics of chemical changes which are reversible. The decomposition of *as*-dimethylcarbamide."

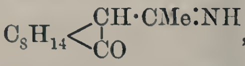
By Charles Edward Fawsitt.

This investigation is a continuation of the work already published on carbamide (*Zeit. physikal. Chem.*, 1902, **41**, 601) and methylcarbamide (*Trans.*, 1904, **85**, 1581). The theory which was put forward to explain the decomposition of carbamide and methylcarbamide holds good also in the present case.

There is in every respect a very strong similarity between the decomposition of *as*-dimethylcarbamide and that of the cases already studied, and there can be no doubt that all the alkylcarbamides decompose in a similar manner.

Dimethylcarbamide decomposes on heating with acids into the corresponding ammonium salt and dimethylamine salt, the mechanism of the change corresponding with a reaction of the first order having a velocity about six times as great as that of carbamide.

*52. "A new formation of acetylcamphor." By Martin Onslow Forster and Hilda Mary Judd.

The *imine*,  $C_8H_{14}<\begin{array}{l}CH\cdot CMe\colon NH\\ \mid\\ CO\end{array}$, obtained by the action of magnesium methyl iodide on α-cyanocamphor, crystallises from petroleum and melts at 126°; it has $[\alpha]_D$ 263·2° in chloroform, and develops an intense blue coloration with alcoholic ferric chloride. It is indifferent towards aqueous alkalis, but is resolved quantitatively by acids into acetylcamphor and ammonia. Magnesium phenyl bromide converts α-cyanocamphor into the corresponding derivative of benzoylcamphor, previously obtained by heating the enolic modification of the diketone with ammonium formate.

The *compound* $C_{12}H_{18}O$, produced when magnesium methyl iodide acts on hydroxymethylenecamphor or its α-benzoyl derivative, is a pleasant-smelling liquid which boils at 228—229° under 764 mm., and has $[\alpha]_D$ 195·0° in chloroform; it is indifferent towards phosphorus pentachloride, phenylcarbimide, hydroxylamine, and ammoniacal silver oxide, but yields camphoric acid with potassium permanganate, which it decolorises immediately. The *dibromide*, $C_{12}H_{18}OBr_2$, melts at 152—153° and has $[\alpha]_D$ 157·2° in chloroform.

The *compound* $C_{13}H_{20}O$, prepared from hydroxymethylenecamphor and magnesium ethyl iodide, boils at 236—238° under 745 mm., and has $[\alpha]_D$ 168·2; its chemical properties resemble those of the lower homologue. The *dibromide*, $C_{13}H_{20}OBr_2$, melts at 88° and has $[\alpha]_D$ 130·5°.

*53. "Preparation and properties of 1:4:5-trimethylglyoxaline." By Hooper Albert Dickinson Jowett.

In the attempt to prepare substances having a constitution analogous to that of pilocarpine, the following compounds were isolated and characterised.

4:5-Dimethylglyoxaline, $C_5H_8N_2$, first prepared by Künne (*Ber.*, 1895, 28, 2039), boils at 165° under 10 mm. pressure and forms a crystalline nitrate (m. p. 180°, not 164° as stated by Künne) and a *picrate*, yellow needles (m. p. 196—197°).

1 : 4 : 5-*Trimethylglyoxaline*, $C_6H_{10}N_2$, boils at 117° under 20 mm. pressure and crystallises in needles (m. p. 46°); the crystals are soluble in all proportions in water, alcohol, or ether. The *nitrate*, $C_6H_{10}N_2,HNO_3,H_2O$, forms long needles (m. p. 46°); the *hydrochloride*, $C_6H_{10}N_2,HCl,H_2O$, forms needles which lose their water of crystallisation over sulphuric acid or at 110°; the anhydrous salt melts at 199°. The following salts were also prepared: the *aurichloride*, yellow needles (m. p. 202°); *platinichloride*, yellow crystals (m. p. 224—225°); *picrate*, yellow needles (m. p. 218°); *methiodide*, long needles (m. p. 158°).

2-*Bromo*-1 : 4 : 5-*trimethylglyoxaline*, $C_6H_9N_2Br,2H_2O$, obtained by the bromination of trimethylglyoxaline, crystallises from hot water in long, silky needles (m. p. 49°); the anhydrous base melts at 83°. The following salts were also prepared: *hydrobromide*, cubical crystals (m. p. 208°); *aurichloride*, yellow needles (m. p. 191°); *picrate*, yellow needles (m. p. 173°).

*54. "Bromomethyl heptyl ketone."
By Hooper Albert Dickinson Jowett.

In the course of some experiments made with the view of preparing the glyoxaline from methyl heptyl ketone, this ketone yielded bromomethyl heptyl ketone by the action of bromine in chloroform solution. By subsequent fractionation of the product, the *bromoketone* was isolated as a pale straw-coloured liquid boiling at 122° under 15 mm. pressure.

0·1256 gave 0·2228 CO_2 and 0·0928 H_2O. C = 48·4; H = 8·2.
0·312 ,, 0·2652 AgBr. Br = 36·2.
$C_9H_{17}OBr$ requires C = 48·8; H = 7·7; Br = 36·2 per cent.

The liquid has the characteristic odour of the ketone and acts very quickly on the eyes, causing a copious flow of tears.

Attempts to condense the bromoketone with potassium phthalimide were unsuccessful.

*55. "Limonene nitrosocyanides and their derivatives."
By Frederick Peacock Leach.

It has been previously shown (*Trans.*, 1904, **85**, 931) that limonene β-nitrosochloride gives rise to a crystalline nitrosocyanide (m. p. 90—91°). The investigation has been continued with the result that both the α- and β-nitrosochlorides of limonene have been found to yield the same isomeric nitrosocyanides, the reaction between the potassium cyanide and the nitrosochlorides being carried out at 25—30°. The nitrosocyanides are unimolecular and optically active and, therefore, analogous to the limonene nitrolamines discovered by Wallach (*Annalen*, 1889, **252**, 113).

The α-nitrosocyanide crystallises in prisms (m. p. 90—91°), whilst the β-compound crystallises in fine, woolly needles (m. p. 140—141°). These isomerides are to be regarded as having the *cis*- and *trans*-configurations, because on hydrolysis, both, by loss of carbon dioxide from their respective acids, give rise to the normal oxime of dihydrocarvone.

From the *d*- and *l*-α-nitrosocyanides were also obtained the benzoyl derivatives (thin plates, m. p. 108°), methyl and ethyl ethers as viscid oils, and the hydrochloride crystallising from alcohol in thin leaves (m. p. 56°).

The *d*- and *l*-benzoyl derivatives of the β-nitrosocyanide each crystallise from dilute alcohol in long, silky needles (m. p. 121°).

The *d*- and *l*-α-amides each gave a methyl ether as a viscid oil, a benzoyl derivative (m. p. 152°), and a hydrochloride (m. p. 100—101°).

The *d*- and *l*-α-acids each gave ammonium and silver salts, the former being finely crystalline and the latter amorphous. The *d*-methyl ester melts at 65°.

Racemic compounds.—α-Nitrosocyanide separates in prisms from petroleum (m. p. 81°), its benzoyl derivative melts at 96°. The β-nitrosocyanide forms fine needles (m. p. 159—160°) and its benzoyl derivative crystallises in needles melting at 98°.

*56. "The action of carbon monoxide on ammonia." By Herbert Jackson and Dudley Northall-Laurie.

The authors have studied the behaviour of these gases when heated together in the presence of platinum, or when subjected to electric sparks or high frequency discharges. They find that the main reaction is the formation of ammonium cyanate, which, under the conditions of the experiment, rapidly changes to carbamide. Hydrogen is produced, and some of this interacts to give water, which in its turn brings about the formation of ammonium carbonate. The amount of ammonium cyanide formed is small. Other products are obtained by prolonging the experiment, but only in quantities which are small compared with the yield of the main product, carbamide.

Discussion.

Professor E. J. Mills said the authors' experiments reminded him of some of his own carried out a number of years ago. He then found that, by passing a current of mixed carbonic oxide and ammonia gas over strongly heated caustic potash in presence of carbon, cyanide was formed in large quantity. In fact, a potassium salt containing more than 70 per cent. of cyanide was readily produced. The carbon, of course, precluded the formation of any cyanate.

*57. "The action of acetylene on aqueous and hydrochloric acid solutions of mercuric chloride."

By John Samuel Strafford Brame.

Bilz and Mumm (*Ber.*, 1905, **37**, 4417) and Hofmann (*Ber.*, 1904, **37**, 4459) show that the white precipitate obtained when acetylene is passed into aqueous mercuric chloride is trichloromercuriacetaldehyde, $\cdot C(HgCl)_3 \cdot CHO$. The author obtained results three years ago which agree closely with those of the above and other observers, but attention is now called to the considerable differences between the determined and calculated values, the analytical results for mercury being very low, whilst those for chlorine are too high. From the reactions, however, the foregoing constitution seems to be the most reasonable one.

Berge and Reychler (*Bull. Soc. chim.*, 1897, **17**, 218) state that acetylene has no action on dilute hydrochloric acid solutions of mercuric chloride, but the author obtained a fine crystalline substance, which was afterwards found to have been described by Biginelli (*Ann. Farm. Chim.*, 1898, 16), who ascribed to it the constitution $Cl \cdot HC \vdots CH \cdot HgCl$ from estimations of mercury and chlorine only. This conclusion has been confirmed by complete analysis and the compound is further described.

Biginelli states that when boiled with water the above compound yields $CH_2 \vdots CH \cdot HgCl$, but the author fails to obtain such a result. It is shown that the product is really trichloromercuriacetaldehyde, but a certain amount of mercurous chloride is also present, this being ascribed to the reducing action of the aldehyde liberated on the mercuric chloride.

Biginelli's statement that $C_2H_2 \cdot HgCl_2$ gives with alkalis an acetylide, $(C_2H_2)_2HgO$, cannot be confirmed, but evidence from analyses and properties shows the substance to be identical with the acetylide $3C_2Hg,H_2O$ described by Travers and Plimpton (*Trans.*, 1894, **65**, 264). Attempts are being made to prepare the anhydrous acetylide.

The first action of acetylene with mercuric chloride appears, therefore, to be one of simple combination, the additive product being then decomposed by water with the production of aldehyde and $C(HgCl)_3 \cdot CHO$.

58. "The basic properties of oxygen at low temperatures. Additive compounds of the halogens with organic substances containing oxygen." By Douglas McIntosh.

Crystalline compounds of chlorine with methyl and ethyl alcohols have been obtained at low temperatures ($-80°$), the formula of the former being probably CH_4OCl, whilst the latter has the composition C_2H_6OCl; their melting points are $-96°$ and $-88°$ respectively. Compounds of a similar type were isolated containing bromine, the methyl alcohol derivative, CH_4OBr, being a red, crystalline substance melting at $-53°$.

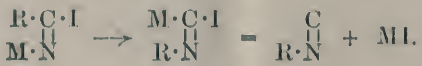
Methyl ether, although not yielding a solid product with chlorine at $-95°$, furnished a bromine compound, C_2H_6OBr, melting at $-68°$. Ethyl ether yielded $C_4H_{10}OCl_2$ (m. p. $-51°$) and $C_4H_{10}OBr_2$ (m. p. $-40°$).

Acetone combined with chlorine to form $C_3H_6OCl_2$ (m. p. $-53°$), whilst with bromine it gave rise to $C_3H_6OBr_2$ (m. p. $-12°$).

Ethyl acetate yielded the additive products $CH_3\cdot CO_2Et,Cl_3$ (m. p. $-64°$) and $CH_3\cdot CO_2Et,Br_3$ (m. p. $-39°$). Acetaldehyde and acetic acid also seem capable of combining additively with chlorine and bromine at low temperatures.

59. "Note on the interaction of metallic cyanides and organic halides." By Nevil Vincent Sidgwick.

It is possible to explain the formation of both nitriles and *iso*cyanides in this reaction by means of the same additive compound, and that of the most probable type, in which the addition has been to the bivalent carbon only. Such a compound, like an unsymmetrical oxime, could exist in two stereoisomeric forms, $\begin{array}{c} R\cdot C\cdot I \\ \| \\ N\cdot M \end{array}$ and $\begin{array}{c} R\cdot C\cdot I \\ \| \\ M\cdot N \end{array}$, where $M = K$, Ag, &c., and $R =$ alkyl or acyl. The first of these would easily lose MI to give a nitrile, in accordance with Nef's view, but the second could not, as the metal and the halogen are too far apart, and it would therefore undergo the Beckmann reaction. This change brings these substituents nearer together, so that now they combine and become eliminated, leaving an *iso*cyanide:



$$\begin{array}{c} R\cdot C\cdot I \\ \| \\ M\cdot N \end{array} \longrightarrow \begin{array}{c} M\cdot C\cdot I \\ \| \\ R\cdot N \end{array} = \begin{array}{c} C \\ \| \\ R\cdot N \end{array} + MI.$$

If this is the case, we must suppose that an alkyl iodide and potassium cyanide, or an acyl halide and silver cyanide (which yield nitriles), give the "*syn*-haloid" form, and an alkyl iodide and silver cyanide the "*anti*-haloid."

It may also be pointed out that neither of the formulæ of hydrocyanic acid can be that of a strong acid, because if it were the alkali salts would be derived from that form, and would not be, as they are, highly hydrolysed in solution.

60. "The chemical dynamics of the reactions between sodium thiosulphate and organic halogen compounds. Part II. Halogen substituted acetates." By Arthur Slator.

Many of the halogen substituted acetates interact more readily with sodium thiosulphate than the corresponding methyl haloids. The reactions with ethyl iodoacetate and methyl, ethyl, and sodium bromo- and chloro-acetates have been investigated and shown in all cases to be bimolecular reactions. The esters are considerably more reactive than the sodium salts. The temperature quotient of the reactions with the esters was found to be in all five cases approximately 2·8; with the sodium salts, an appreciably smaller value was obtained. The reaction between ethyl bromoacetate and potassium, ammonium, barium, strontium, sodium silver, lead and sodium lead thiosulphates have been measured, and from the results obtained it is probable that the reaction is primarily connected with the S_2O_3'' ion, and that the undissociated or partially dissociated salts are relatively inactive. The velocity of reaction is proportional to the concentration of the S_2O_3'' ion, and the measurements may therefore be used to estimate such concentrations. The dissociation constant of lead thiosulphate measured in this way was found to have the value $[Pb^{\cdot\cdot}][S_2O_3'']/[PbS_2O_3] = 1{\cdot}5 \times 10^{-4}$.

61. "The tautomerism of acetyl thiocyanate."
By Augustus Edward Dixon and John Hawthorne.

When acetyl thiocyanate is brought into contact with aniline at temperatures ranging from − 12° to about 120°, in presence of an inert solvent, such as benzene, interaction occurs spontaneously, with development of much heat, the chemical changes running concurrently on two distinct lines: (1) a change by double decomposition, in which the sulphur appears wholly in the form of thiocyanic acid, as shown by the equation $Ac{\cdot}SCN + 2PhNH_2 = Ac{\cdot}NHPh + PhNH_2,HSCN$; (2) an additive process in which the sulphur plays a thiocarbimidic part, thus: $Ac{\cdot}NCS + PhNH_2 = AcNH{\cdot}CS{\cdot}NHPh$. At 87°, one-half of the total weight of product consists of acetanilide together with aniline thiocyanate, the remainder being acetylphenylthiocarbamide; at lower temperatures, the proportion of thiocyanate and anilide rises, and for temperatures below 30° reaches 90 per cent. and upwards of the total, whilst at temperatures above 87° the proportions are reversed, the yield of thiocarbamide increasing, with a corresponding decrease in the amount of the other two products, until in the neighbourhood of 120° the sum of the latter diminishes to some 2 or 3 per cent.

Although the thiocarbimidic character of acetyl thiocyanate, as measured by its power to yield the additive compound, acetylphenylthiocarbamide, increases regularly with the temperature of interaction, it would seem that this power is not acquired through ordinary isomeric change. For in all cases hitherto observed, the transformation by heat of a thiocyanate into a thiocarbimide is non-reversible, the latter representing the stable and permanent form, whereas here the percentage of acetylphenylthiocarbamide resulting at any given temperature is not affected by previous heating of the thiocyanate, but is determined solely by its temperature at the moment of interaction.

These phenomena come neither under the head of tautomerism proper, which is conditioned through the intramolecular migration of a hydrogen atom, nor into the category of migration of whole atomic groups: in point of elasticity, they present some resemblance to dissociation changes, but until further inquiry has been made the authors prefer not to advance definite views as to their nature and causation.

62. "A method of determining the specific gravity of soluble salts by displacement in their own mother liquor, and its application in the case of the alkali halides." By John Young Buchanan.

The method presents obvious difficulties of manipulation, but as it furnishes at one and the same time the specific gravity of the salt and that of its mother liquor, both being determined at the temperature of equilibrium, it may be sometimes advisable to encounter these difficulties.

This method has been applied in the case of the chlorides, bromides, and iodides of potassium, rubidium, and cæsium, and the following are the values obtained for the specific gravity D of each of these salts at the temperature T', referred to that of distilled water at the same temperature as unity.

Salt, MR.	KCl.	KBr.	KI.	RbCl.	RbBr.	RbI.	CsCl.	CsBr.	CsI.
Temp. T.	23·4°	23·4°	24·3°	22·9°	23·0°	24·3°	23·1°	21·4°	22·8°
Sp. gr. D.	1·951	2·679	3·043	2·706	3·210	3·428	3·982	4·455	4·508

63. "The combination of mercaptans with unsaturated ketonic compounds." By Siegfried Ruhemann.

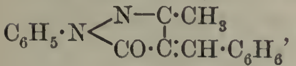
The author has continued his research (*Trans.*, 1905, **87**, 17) on the union of mercaptans with olefinic ketonic compounds effected under the influence of bases, since on using hydrogen chloride as catalytic agen Posner frequently obtained mixtures, owing to the fact that mercaptans, besides combining additively at the ethylene linking, partly condensed with the ketonic group. Besides the compounds which previously had been described as being formed from mercaptans and mono-olefinic ketones, $\overset{|}{C}:\underset{|}{\overset{|}{C}}\cdot CO-$, other substances have been prepared by the union of benzylideneacetophenone and ethyl benzylidenebenzoylacetate.

Cinnamylideneacetophenone, the di-olefinic ketone of the type $\underset{|}{\overset{|}{C}}:CH\cdot CH:CH\cdot CO-$, as shown before (*loc. cit.*), takes up 1 mol. only of either phenyl mercaptan or *iso*amyl mercaptan, instead of 2 mols., as stated by Posner (*Ber.*, 1904, **37**, 509). This investigator has since acknowledged the error. The behaviour of cinnamylideneacetone is analogous; this substance unites with 1 mol. of phenyl mercaptan to yield the compound $C_6H_5\cdot CH:CH\cdot CH(S\cdot C_6H_5)\cdot CH_2\cdot CO\cdot CH_3$ (m. p. 53—54°), whilst according to Posner's statement an oil is thus formed, which on oxidation is transformed into a disulphone.

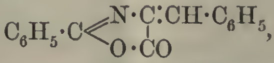
In harmony with the author's result is the fact that cinnamylidenebenzylideneacetone, $C_6H_5\cdot CH:CH\cdot CH:CH\cdot CO\cdot CH:CH\cdot C_6H_5$, unites with 1 mol. of either *iso*amyl mercaptan or phenyl mercaptan, but 2 mols. of mercaptan may also be added to the tri-olefinic ketone, yet the separation of the compound from the additive product with 1 mol. of the mercaptan which is formed at the same time has not been effected.

Moreover, the acetylenic ketone, methoxybenzoylphenylacetylene, $C_6H_5\cdot C⋮C\cdot CO\cdot C_6H_4\cdot O\cdot CH_3$, unites with 1 mol. of phenyl mercaptan to form $C_6H_5\cdot C(S\cdot C_6H_5):CH\cdot CO\cdot C_6H_4\cdot O\cdot CH_3$ (m. p. 121—122°), which is yellow as compared with the additive substances of mercaptans with olefinic ketones, which are almost all colourless.

The olefinic cyclic ketones, benzylidenephenylmethylpyrazolone,



$C_6H_5\cdot N\Big<\begin{matrix}N-C\cdot CH_3\\ \qquad | \\ CO\cdot C:CH\cdot C_6H_6\end{matrix}$, and benzylidenephenylazlactone,



$$C_6H_5\cdot C\Big<\begin{matrix}N\cdot C:CH\cdot C_6H_5\\ \quad | \\ O\cdot CO\end{matrix},$$

unite with phenyl mercaptan, but, whilst the pyrazolone derivative forms an additive product (m. p. 140°) with 1 mol. of the mercaptan, the azlactone takes up 2 mols. of phenyl mercaptan to yield a compound (m. p. 156—157°) which probably has the formula

$$C_6H_5{\cdot}CH_2(S{\cdot}C_6H_5){\cdot}C(CO{\cdot}S{\cdot}C_6H_5){\cdot}NH{\cdot}CO{\cdot}C_6H_5.$$

64. "The existence of a carbide of magnesium." By J. Trengove Nance.

The residue left after burning magnesium in carbon dioxide, if shaken with water or dilute hydrochloric acid, gives a smell resembling that of geraniums. This smell is always obtained when magnesium is heated with carbon, or in air containing carbon dioxide, and the residue treated as above. It is due to the presence of a hydrocarbon formed by the action of water on the residue, for it is driven off by heat, can be concentrated in a distillate, and if the gas is passed through a red hot tube together with air, carbon dioxide is formed.

The presence of acetylene from a carbide of magnesium being suspected, a mixture of magnesium powder and powdered wood charcoal was gently ignited. The yellowish residue was treated with dilute hydrochloric acid, and the gas, mainly hydrogen, which was vigorously evolved, gave the following indications of the presence of acetylene. It burnt with a faintly luminous, two-zoned flame, and when passed through ammoniacal cuprous chloride it produced a brownish-red precipitate. With ammoniacal cupric solutions, decolorised by hydroxylamine, a brilliant crimson precipitate was obtained (compare Ilosvay von Nagy Ilosva, *Ber.*, 1899, **32**, 2697; *Abstr.*, 1900, ii, 52). These precipitates dissolved, wholly or partially, in dilute hydrochloric acid, with evolution of acetylene, copper passing into solution.

By analogy, the carbide formed should be MgC_2, but it was not obtained in a sufficiently pure condition for a quantitative analysis. It does not seem to interact as vigorously with water as the calcium compound.

65. "Isomeric salts of the type $NR_1R_2H_3$. A correction. Isomeric forms of *d*-bromo- and *d*-chloro-camphorsulphonic acids." By Frederic Stanley Kipping.

The further study of the isomeric *α*- and *β*-salts, which the author obtained by combining ordinary *d*-bromo- and *d*-chloro-camphorsulphonic acids with *dl*- and with optically active bases, such as hydrindamine (*Trans.*, 1900, **77**, 861; 1903, **83**, 873), benzylhydrindamine (Kipping and Hall, *Trans.*, 1901, **79**, 430), methylhydrindamine (Tattersall and Kipping, *Trans.*, 1903, **83**, 918), and *l*-menthylamine (Tutin and Kipping, *Trans.*, 1904, **85**, 65), has brought to light the fact that the isomerism of these compounds is not determined by a difference in the arrangement in space of the groups united with the quinquevalent nitrogen atom, such as is represented by the symbols $X-\overset{|}{\underset{\wedge}{N}}-H$ and $H-\overset{|}{\underset{\wedge}{N}}-X$, but to the existence of *cis-* and *trans-*forms of *d*-bromo- and *d*-chloro-camphorsulphonic acids, containing the groups $X-\overset{|}{\underset{|}{C}}-H$ and $H-\overset{|}{\underset{|}{C}}-X$, and now distinguished as the *α*- or normal and *β*- or *iso*-acids.

The isomeric acids are stable in neutral solutions of their salts in the free state and in presence of mineral acids, even at 100°; in presence of a free base, however, such as caustic potash, baryta (sodium carbonate), hydrindamine, &c., the salts of the normal acid are transformed to a small extent into those of the *iso*-form, whereas the latter are almost entirely converted into salts of the normal acid, equilibrium being attained apparently when at least 90—95 per cent. of the compound exists in the normal form. During this change, the two modifications doubtless become identical, both passing through one and the same unstable enolic form.

All the salts of ordinary *d*-bromocamphorsulphonic acid which have hitherto been described by the author and by others, excepting those obtained from *d*- and *l*-hydrindamine and then separated from the *β*-forms, are probably mixtures of the two isomerides; the only salts of the *iso*-acids which are yet known are those previously described as *βl*-hydrindamine *d*-bromocamphorsulphonate and the *β*-modifications of *d*- and *l*-hydrindamine chlorocamphorsulphonates.

The molecular rotation of *iso-d*-bromocamphorsulphonic acid is approximately $[M]_D$ +177°, that of the corresponding chloro-acid being about $[M]_D$ +233°, so that in one case the normal, in the other the *iso*-acid has much the higher value.

No new facts have yet been obtained as to the cause of the formation of the isomeric salts of *cis-π*-camphanic acid, but in view of the above-mentioned results it would seem that the explanation previously suggested is not the true one.

66. "Isomerism of *α*-bromo- and *α*-chloro-camphor."

By Frederic Stanley Kipping.

The fact that the sulphonic acids derived from *α*-bromo- and *α*-chlorocamphor may be transformed into isomerides by the action of bases rendered it extremely probable that the simple halogen derivatives themselves would give rise to isomerides under similar conditions: the following experiments show this to be the case.

Pure ordinary *α* bromocamphor, dissolved in 96 per cent. alcohol, gave $[\alpha]_D+135°$; on adding a very small quantity of sodium ethoxide to the solution, the specific rotation fell to $[\alpha]'_D + 122°$, a value which did not change appreciably during 24 hours or on acidifying the solution with acetic acid. Ordinary bromocamphor, therefore, is partially converted into the *iso*-form, which has a lower specific rotation, and in the alkaline solution a condition of equilibrium between the isomerides is rapidly attained.

Judging from the behaviour of bromocamphorsulphonic acid, this *iso*-α-bromocamphor should be stable in acid solution. Accordingly some ordinary bromocamphor was treated in alcoholic solution with sodium ethoxide and the solution almost immediately acidified ; on evaporating, crystals of ordinary bromocamphor were first deposited ; these were separated from the mother liquor and treated again with sodium ethoxide and acid successively, these operations being repeated several times. The combined mother liquors gave on evaporation an oily deposit which was distilled in steam, and then fractionally crystallised from light petroleum : the first deposits consisted of ordinary bromocamphor, but the later fractions crystallised slowly in camphor-like masses. The specific rotation of this product, which no doubt still contained ordinary bromocamphor, was $[\alpha]_D + 38{\cdot}5°$ in 96 per cent. alcohol ; when, however, a trace of sodium ethoxide was added to the alcoholic solution, the specific rotation increased rapidly and attained a constant value approximately the same as that of the solution of ordinary bromocamphor to which sodium ethoxide had been added.

When, moreover, the camphor-like mass was dissolved in a little alcohol and a few drops of caustic soda added, a large quantity of ordinary bromocamphor separated in crystals.

These experiments seem to establish the existence of normal and *iso*-forms of α-bromocamphor, and they explain the use of the caustic potash or caustic soda which is added in isolating ordinary bromocamphor from the crude product of the bromination of camphor : this crude product, as shown by Marsh (Trans., 1890, **57**, 828), doubtless consists of a mixture of the two isomerides, possibly together with unchanged camphor, but the isolation of the pure *iso*-form would most likely be a very hard task, which, as Marsh himself suggests, he probably did not accomplish. Similar experiments to the above indicate that ordinary α-chlorocamphor is also capable of existence in a stable *iso*-form, and the matter is being further investigated.

67. "*l*-Phenylethylamine." By Frederic Stanley Kipping and Albert Edward Hunter."

In number 3 of the current *Berichte* (**38**, 801) there appears a paper by Marckwald and Meth, "Über Amidbildung zwischen optisch-activen Säuren und Basen und die optisch-activen α-Amidoethylbenzolen," containing certain statements respecting some work of ours to which we take exception (*Trans.*, 1903, 83, 1147). Firstly, "Ihnen gelang wohl die Reindarstellung des Salzes der *l*-Base, aber die gewonnene Menge reichte zur Isolirung der reinen Base nicht aus"; also "K. & H. haben aus Mangel an Material das Drehungsvermögen des von ihnen gewonnenen *l*-Phenyläthylamin nur in wässrig alkoholischer Lösung bestimmt."

Neither statement is correct; we did not prepare the anhydrous base or determine its specific rotation merely because we were solely engaged in studying its salts.

The statement "Demnach haben Kipping and Hunter annähernd reines *l*-Phenylathylamin in Händen gehabt" suggests that our base contained some of the *d*-isomeride; this was not the case, and the specific rotation (–3·7°) of the hydrochloride prepared by us was in fact slightly higher than that (–3·5°) of Marckwald and Meth's preparation, although the difference is within the limits of experimental error.

The fact that the benzoyl derivative of the *l*-base melts at the same temperature as that of the *dl*-base, when both are crystallised from alcohol, and the fact that the specific rotation of the *l*-benzoyl derivative is extremely small according to Marckwald and Meth (only +0·3° in alcoholic solution) led us to state that the base "seems" to undergo racemisation during the preparation of its benzoyl derivative; our statement that "mixtures of the three compounds also melted at 120°" (*loc. cit.*, p. 1148) is doubtless correct, as the mixtures consisted of approximately equal quantities of the *d*-, *l*- and *dl*-benzoyl derivatives, and we omitted to examine the behaviour of a mixture of the *l*- and *dl*-compounds only.

68. "The influence of the hydroxyl and alkoxyl groups on the velocity of saponification. Part I." By Alexander Findlay and William Ernest Stephen Turner.

The following values of the saponification constant in aqueous solution have been determined (at 25°):

Ester.	*k*.	Ester.	*k*.
Ethyl phenylacetate	12·4	Ethyl phenylmethoxyacetate	23·3
Methyl mandelate	157	Ethyl phenylethoxyacetate	15·7
Ethyl mandelate	66	Ethyl phenylpropoxyacetate	(13·3)
Propyl mandelate	55		

The value for ethyl phenylpropoxyacetate was calculated from the values obtained in alcoholic solution.

The numbers in the foregoing table show at once the greatly accelerating influence which the hydroxyl group exercises on the velocity of saponification, the constant being increased to about five times (for example, ethyl phenylacetate and ethyl mandelate). The increase in the affinity constants of the corresponding acids is about eight times. On replacing the hydrogen of the hydroxyl by an alkyl group, the velocity of saponification is diminished, and the diminution increases regularly with the mass of the alkyl group.

The velocity of saponification was also studied in aqueous alcoholic solution, the strength of which was 30 and 60 per cent. by weight. The values obtained were of course diminished by the addition of alcohol; they are contained in the following table:

Ester.	In 30 per cent alcohol. k.	In 60 per cent. alcohol. k.
Ethyl phenylacetate	8·6	(6)
Methyl mandelate	(109)	(84)
Ethyl mandelate	49·4	29·1
Propyl mandelate	39·5	22·7
Ethyl phenylmethoxyacetate......	15·2	(8)
Ethyl phenylethoxyacetate	10·2	(6)
Ethyl phenylpropoxyacetate	—	(5)

The numbers enclosed in brackets are only approximate, as in the case of the esters to which they apply there was a great decrease in the value of the "constant" with the time.

At the next Ordinary Meeting, on **Wednesday**, April **19th**, 1905, at **5.30** p.m., the following paper will be communicated:

"Complex nitrites of bismuth." By W. C. Ball.

"*C*-Phenyl-*s*-triazole." By G. Young.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/4/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 294.

Wednesday, April 19th, 1905. Professor R. Meldola, F.R.S., President, in the Chair.

Mr. B. Perrott was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Joseph Bennett, North Adams, Mass., U.S.A.
Ralph Emerson De Lury, M.A., Manilla, Ontario, Canada.
Robert Donald, M.A., B.Sc., M.R.C.S., L.R.C.P., D.P.H., 75, Clyde Street, Dunedin, N.Z.
Ernest Lyle Carman Forster, M.A., Brampton, Ontario, Canada.

Of the following papers, those marked * were read:

*69. "Complex nitrites of bismuth."
By Walter Craven Ball.

A very unstable, yellow, crystalline *substance*, probably

$$Bi(NO_2)_3,2NH_4{\cdot}NO_2,NH_4{\cdot}NO_3,NaNO_3,$$

is precipitated by dissolving bismuth nitrate in sodium nitrite solution and pouring the resulting orange-coloured liquid into a saturated solution of ammonium nitrate at 0°. A more stable yellow compound, *bismuth sodium ammonium nitrite*, $Bi(NO_2)_3,2NH_4{\cdot}NO_2,NaNO_2$, which crystallises in octahedra, is obtained by dissolving bismuth nitrate in concentrated ammonium nitrate solution and adding the resulting liquid to a saturated solution of sodium nitrite, cooled to 0°, and acidified with nitrous fumes.

A fairly stable, orange-yellow, *bismuth potassium nitrite*,

$$Bi(NO_2)_3,3KNO_2,H_2O,$$

is formed when nitrous fumes are passed into bismuth hydroxide suspended in a concentrated solution of potassium nitrite. All these salts, which are decomposed by water, have a slight green fluorescence.

Discussion.

Dr. L. F. Guttmann said that if the compounds described were analogous to the complex cobaltinitrites, it should be possible to prepare the corresponding barium or calcium double salt from the potassium compound, and asked whether the author had attempted to do so.

Mr. E. Grant Hooper expressed the opinion that precipitates produced as these substances were from saturated solutions might be expected to exhibit fair uniformity of composition if deposited under identical conditions, and that even close similarity of composition could not, in such circumstances, be deemed evidence that one was dealing with actual compounds, and not merely mixed salts. He thought that especial care was necessary when the "compounds" were immediately decomposed either in the process of recrystallisation or by any other treatment employed with the view of testing their individuality.

Mr. Ball, in reply, said that he had not succeeded in preparing pure specimens of other complex salts from the alkali double nitrites, mainly owing to their decomposition by solvents.

Mr. Hooper's view that these substances might be mixtures was rendered improbable by the fact that they had a well-defined crystalline form; moreover, they remained constant in composition even when prepared under varying conditions.

*70. "Experiments on the synthesis of the terpenes. Part II. Synthesis of Δ^{3}-*p*-menthenol(8), $\Delta^{3:8(9)}$-*p*-menthadiene, *p*-menthanol(8), $\Delta^{8(9)}$-*p*-menthene, and *p*-menthane." By William Henry Perkin, jun., and Samuel Shrowder Pickles.

The authors deal with some hitherto unknown members of the terpene series which have been synthesised by employing Δ^{1}-tetrahydro-

p-toluic acid instead of Δ^3-tetrahydro-*p*-toluic acid, and describe the synthesis of those compounds enumerated in the title.

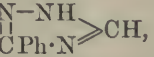
***71. "Experiments on the synthesis of the terpenes. Part III. Synthesis of aliphatic compounds similar in constitution to terpineol and dipentene." By William Henry Perkin, jun., and Samuel Shrowder Pickles.**

The authors describe the preparation of open chain compounds allied as closely as possible to the typical substances, terpineol and dipentene, in order to determine whether any great similarity in properties exists between such compounds and those members of the terpene group. The results indicate that probably the closed chain structure has a distinct influence on the properties of the terpenes and their derivatives.

***72. "Experiments on the synthesis of the terpenes. Part IV. Synthesis of Δ^3-normenthenol(8), $\Delta^{3:8(9)}$-normenthadiene, normenthanol(8), and $\Delta^{8(9)}$-normenthene." By Kōichi Matsubara and William Henry Perkin, jun.**

In view of the close relation between terpenoid compounds and cymene, the authors have prepared a number of substances allied to those described in Part II of this investigation, but differing from them in that they do not contain the methyl group.

73. "*C*-Phenyl-*s*-triazole." By George Young.

C-Phenyl-*s*-triazole,  $\begin{matrix}\text{N—NH}\\ \| \\ \text{CPh·N}\end{matrix}\!\!>\!\text{CH}$, previously obtained from 3-phenyl-1-methylhydroxy-1 : 2 : 4-triazole (*Trans.*, 1901, **79**, 665), has now been prepared from *C*-phenylhydroxy-*s*-triazole (*Trans.*, 1900, **77**, 226); it melts at 119·5—120°. The *silver nitrate* derivative, $C_8H_6N_3Ag,AgNO_3,H_2O$, is obtained as a white precipitate; the platinichloride, $(C_8H_7N_3)_2,H_2PtCl_6,3H_2O$, when treated with water, is converted into $(C_8H_{17}N_3)_2PtCl_4,3H_2O$. The *acetyl* derivative, $C_8H_6N_3{\cdot}C_2H_3O$, melts at 90°; the *carbamido*-derivative,

$$C_8H_6N_3{\cdot}CO{\cdot}NH_2,$$

melts at 117°.

74. "The resolution of inactive glyceric acid by fermentation and by brucine." By Percy Faraday Frankland and Edward Done.

Neuberg and Silbermann (*Ber.*, 1904, **37**, 339) state that by the action of lime on *d*-glucuronic acid they have obtained a glyceric acid, of which the anhydrous barium salt in aqueous solution gives $[\alpha]_D$ $+17\cdot1^\circ$, whilst by the resolution of inactive glyceric acid with brucine the enantiomorphous barium salt, with rotation $[\alpha]_D$ $-17\cdot4^\circ$, was obtained.

These mutually corroborative results were calculated to throw the gravest doubt on the accuracy of the rotation, $[\alpha]_D^{20^\circ} -10\cdot01^\circ$, given by P. Frankland and Appleyard (*Trans.*, 1893, **63**, 299) for the barium salt of the active glyceric acid obtained by the fermentation of inactive calcium glycerate with the *Bacillus ethaceticus* (P. Frankland and Frew, *Trans.*, 1891, **59**, 81 and 96), whilst the optical purity of all the numerous other derivatives of the active fermentation glyceric acid were also thereby discredited.

The authors have in consequence reinvestigated the barium salts obtainable from the fermentation acid, on the one hand, and from brucine resolution of the inactive acid on the other, with the result that both salts were found to have the same rotation, $[\alpha]_D^{20^\circ} -10\cdot9^\circ$, which is thus entirely at variance with the figures of Neuberg and Silbermann. The clue to this unaccountable discrepancy was, however, wanting until quite recently, when Neuberg and Silbermann, in a foot-note at the end of a publication in the *Zeitschrift für Physiologische Chemie* (1905, **44**, 146), explained that the above values previously given by them for the rotation of the *d*- and *l*- glycerates of barium were erroneous through their having used a faulty polarimeter (displacement of the zero of the instrument).

The complete coincidence between the activity of the barium salt of the fermentation acid and of that of the acid obtained by resolution with brucine conclusively proves, not only the optical purity of each, but also the reliability of the material (the active calcium glycerate of P. Frankland and Frew) from which so many optically active derivatives have been prepared.

The fractionally higher specific rotation for the barium salt found by the authors, as compared with that given by P. Frankland and Appleyard, is doubtless to be accounted for by the circumstance that the salt has now been obtained in a more perfectly crystalline condition. The calcium salt, which had already previously been obtained in large crystals, exhibited the same rotation as before.

75. "Estimation of potassium permanganate in the presence of potassium persulphate." By John Albert Newton Friend.

The author shows that small quantities of potassium permanganate may be correctly estimated iodometrically in the presence of potassium persulphate when the following precautions are observed:

1. The solution should be diluted to at least 150 c.c. before addition of the iodide.
2. Very little more iodide should be added than is necessary to reduce the permanganate.
3. The acidity should be reduced to a minimum.

In this way, small quantities of permanganate may be estimated in the presence of as much as 0·08 gram of persulphate.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Baker, Julian L. The brewing industry. pp. xii + 178. ill. London 1905. (*Recd.* 24/3/05.) From the Author.

Hoff, J. H. van't. Zur Bildung der ozeanischen Salzablagerungen. Heft 1. pp. vi + 85. ill. Braunschweig 1905. (*Recd.* 16/3/05.) From the Publishers.

Nieuwland, Julius A. Some reactions of acetylene. pp. 152. ill. Notre Dame, Indiana 1904. (*Recd.* 22/3/05.) From the Author.

Thomsen, Julius. Systematisk gennemførte termokemiske Undersøgelsers numeriske og teoretiske Resultater. pp. xii + 472. Copenhagen 1905. (*Recd.* 13/3/05.) From the Author.

Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome II, Fasc. 1. Tome IV, Fasc. 1. pp. v + 384, v + 592. (*Recd.* 6/4/05.) From Professor Henri Moissan.

Walmsley, R. Mullineux. Electricity in the service of man. pp. viii + 1208. ill. London 1904. From the Author.

II. *By Purchase.*

Godfrey, Ambrose and John. A curious research into the element of water; containing many noble and useful experiments on that fluid body. pp. 18. London 1747. (*Recd.* 23/3/05.)

Haller, A. Les récents progrès de la chimie. Conférences faites au Laboratoire de chimie organique de la Sorbonne, sous la direction de M. A. Haller. pp. 320. Paris 1904. (*Recd.* 12/4/05.)

Ingenhousz, John. Experiments upon vegetables, discovering their great power of purifying the common air in the sunshine, and of injuring it in the shade and at night; to which is joined, a new method of examining the accurate degree of salubrity of the atmosphere. pp. lxviii + 302 + xvii. London 1779. (*Recd.* 23/3/05.)

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Richter, V. von. Chemie der Kohlenstoffverbindungen oder organische Chemie. Zehnte Auflage. Band II. Carbocyclische und heterocyclische Verbindungen. Von R. Anschütz und G. Schroeter. pp. xxi + 894. Bonn 1903. (*Recd.* 13/4/05.)

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Schmidt, Julius. Die Chemie des Pyrrols und seiner Derivate. pp. xii + 305. Stuttgart 1904. (*Recd.* 12/4/05.)

Simpson, W. Zymologia Physica; or, a brief philosophical discourse of fermentation from a new hypothesis of acidum and sulphur. Whereby the phœnomena of all natural hot baths, the generation of minerals, the production of many acidulæ or spaw-waters, the grand apparences of heat, fire, and light, throughout the triplicity of nature's dominions, in the productions of bodies, are solv'd from the intestine duellings and inward collisions of the foresaid principles. Whereby also various other subterraneal phœnomena, as damps, earthquakes, eruptions, etc., likewise the apparances of meteors, etc., and divers other no less remarkable then entertaining, are from the same doctrine of fermentation genuinely solv'd. With an additional discourse of the sulphur-bath at Knarsbrough. pp. xii + 152. London 1675. (*Recd.* 7/3/05.)

Strutt, Hon. R. J. The Becquerel Rays and the properties of radium. pp. vii + 214. ill. London 1904. (*Recd.* 17/2/05.)

Sue, Pierre. Histoire du galvanisme; et analyse des différens ouvrages publiés sur cette découverte, depuis son origine jusqu'à ce jour. 2 vols. pp. xxiv + 335, 493. ill. Paris 1802. (*Recd.* 23/3/05.)

Valeur, Amand. Chimie et toxicologie de l'arsenic et de ses composés. pp. 364. ill. Paris 1904. (*Recd.* 7/3/05.)

Wilhelmy, Ludwig. Ueber das Gesetz, nach welchem die Einwirkung der Säuren auf den Rohrzucker stattfindet, 1850. Herausgegeben von W. Ostwald. (Ostwald's *Klassiker*, No. 29.) Leipzig 1891. (*Recd.* 28/2/05.)

III. *Pamphlets.*

Bradley, W. P., Browne, A. W., and Hale, C. F. Effect of mechanical vibration upon carbon dioxide near the critical temperature. (From the *Physical Review*, **19**, 1904.)

Calm, C. E. Sulphurous acid and sulphites as food preservatives. pp. 34. Chicago [1904].

Clarke, Frank Wigglesworth. The progress and development of chemistry during the nineteenth century. (From the *George Washington University Bulletin, Oct.* 1904.)

Ingenhousz, Jean. Observations sur la construction et l'usage de l'eudiomètre de M. Fontana, et sur quelques propriétés particulières de l'air nitreux. (From the *Journal de physique*, 1785.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can obtained from the Assistant Secretary, must be received on or before Monday, June 5th, 1905.

At the next Meeting, on **Thursday**, May **4th**, 1905, at **8 p.m.**, there will be a ballot for the election of Fellows, and the following papers will be communicated :

"The synthesis of substances allied to adrenalin." By H. D. Dakin.

"Methylation of *p*-aminobenzoic acid by means of methyl sulphate." By J. Johnston.

"Some notes on sodium alum." By J. M. Wadmore.

"Camphoryl-ψ-semicarbazide." By M. O. Forster and H. E. Fierz.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, May 4th, 1905.

Amos, Arthur,

Spring Grove, Wye, Kent.

Agricultural Research at Rothamsted Laboratory. B.A., Cambridge, 1904. First Class Nat. Sci. Tripos, Part I.

A. D. Hall. Horace T. Brown.
N. H. J. Miller. E. J. Russell.
Henry Jackson.

Andrews, Albert Edward,

37, Oakhurst Grove, East Dulwich, S.E.

Assistant Chemist in the Research Laboratories of the Imperial Institute, S.W. Three years' course (1893—1896) in Chemistry at Finsbury Technical College, Leonard Street, E.C. Have since been continuously engaged under Professor Dunstan in the Research Laboratories of the Imperial Institute, where I now hold the Salters' Company's Research Fellowship.

Wyndham R. Dunstan. John Castell-Evans.
R. Meldola. Thomas A. Henry.
Ernest Goulding.

Baxter, John George,

"Court Solo," Cliffe, near Rochester, Kent.

Analytical Chemist. Served an Apprenticeship to an Analytical Chemist in business in Manchester. Have been manager of Chemical Works in London. Have erected and managed a small explosive works. Have been for 2 years Chemist to Cement Works and for the last 2 years Manager of Nine Elms Cement, Lime and Whiting Works. Have been Member of Society of Chemical Industry for many years.

H. H. Slater. H. Ellison, jun.
E. J. Read. J. Marsh.
W. J. Dibdin.

Belton, Francis George,
16, Clarkson St., Sheffield.

Student of Chemistry and Metallurgy. For 4 years assistant chemist to the Frodingham Iron and Steel Co., at present student of advanced chemistry at University College, Sheffield.

W. Palmer Wynne. W. E. S. Turner.
A. N. Meldrum. *L. T. O'Shea.*
Thos. Andrews.

Brettell-Vaughan, Edward Shipley Hewett Edwards, M.R.A.C.,
The Cwm, Aston-on-Clun, Salop.

Junior partner in firm of Vicarey & Co. (Consulting Experts of Storage Batteries), engaged in Research Laboratory on Chemistry of Fats, Oils, and Greases. Royal Agricultural College, Cirencester, Honours Degree of M.R.A.C. and holder of Certificates of Honour and Merit and Prizeman (by examination). Desirous of being in touch with the Society for purpose of consulting library and gaining the last and best possible works and literature on chemistry in general.

Maurice Blood. R. C. Marchant.
J. H. Davidson. Edward Kinch.
F. H. Alcock.

Clark, Thomas Walter Firth,
117, Clerkenwell Road, E.C., London.

Assistant Chemist. Twelve years in the Analytical and Manufacturing Laboratories of Messrs. Burgoyne, Burbidges & Co. Formerly Student at Finsbury Technical College and East London Technical College.

J. T. Hewitt. R. G. Halstead.
John Castell-Evans. *R. Meldola.*
Thos. Farries. *Clarence Smith.*
T. Pitt.

Colles, William Morris, jun.,
16, Birchington Road, West Hampstead, N.W.

Student. Worked in the Chemical Laboratory at University College for 5 years. B.Sc. (Lond.) Internal. 2nd Class Hons. Chemistry.

William Ramsay. Edward C. Cyril Baly.
J. Norman Collie. Samuel Smiles.
A. W. Stewart.

Coupe, Miles,

46, Millarbarn Lane, Waterfoot, near Manchester.

Works Chemist. Student of Chemistry and Dyeing for 10 years in various laboratories, including Bury and Rochdale Technical Schools, and the Manchester School of Technology. 1st Class Honours Chemistry, and Holder of various other certificates of the Board of Education. Silver Medallist in Honours Wool Dyeing, 1901, in Honours Silk Dyeing, 1902, and in Honours Calico Printing, 1903, under the City and Guilds; also several Honours Certificates (Coal-tar Products, &c.). I am engaged in Research Work.

J. C. Cain.
Jul. Hübner.
W. J. Pope.
John Horsfall.
William Marshall.
L. G. Radcliffe.
Stanley J. Peachey.
Jas. Grant.

Dodds, Roger,

Bigods Hall, Dunmow, Essex.

Science Master. Associate in Science and qualified in science portion of Examination for B.Sc. degree (University of Durham). Several years' experience in Technical Chemistry, in Cement Manufactory, and in Incandescent Lamp Factory.

P. Phillips Bedson.
F. C. Garrett.
S. Hoare Collins.
J. T. Dunn.
James Whittle.

Dunstan, Sydney,

107, Jesmond Road, Newcastle-on-Tyne.

Head Dispenser and Teacher of Pharmacy to the Royal Infirmary, Newcastle-on-Tyne. Member of the Pharmaceutical Society. Charge of Laboratory, the London Hospital, E. Assisted Dr. R. Hutchison in the analysis of Patent Medicines. Conducted all the experimental work during the compilation of the London Hospital Pharmacopœia. My studies in Analytical Chemistry were directed by Professors J. N. Collie, D.Sc., F.R.S., and A. Lapworth, D.Sc.

H. C. T. Gardner.
Frederic Jas. M. Page.
Hugh Candy.
Geo. F. Merson.
P. Phillips Bedson.

Evans, Bernard Scott,

Ferndale, 81, Babington Road, Streatham, S.W.

Analyst. B.Sc. Lond. 3½ years assistant to Leo Taylor, Esq., F.I.C., Public Analyst for Hackney. 4 years assistant to Lawrence Briant, Esq., F.C.S.

Lawrence Briant.
Arthur J. Starey.
John T. Norman.
Percy Edgerton.
Harold W. Harman.

Ferrier, John Greig,

2, Dalhousie Place, Arbroath, N.B.

Manufacturing Chemist. Pharmaceutical Chemist. Licentiate Pharmaceutical Society of Ireland. In charge of Pharmaceutical Laboratory, Abbeyhill Chemical Works, Edinburgh. Contributed "The Official Formulæ for Magnesium, Zinc and Lead Carbonates" (*Ph. J.*, pp. 586—587).

W. Watson Will.
H. Lucas.
F. Filmer De Morgan.
David J. Williams.

William Duncan.
Leonard Dobbin.
J. Gibson.
John Hunter.

Findon, Frank Standish,

41, Great Percy Street, Holford Square, W.C.

Clerk in Holy Orders. B.Sc. (St. Andrews University) with distinction in Chemistry; M.A. (2nd class Honours in Mathematics and Physics); formerly Science Master, Aberayron Intermediate School.

Thomas Purdie.
Alex. McKenzie.

G. D. Lander.
Alex Findlay.

Percy F. Frankland.

Finnemore, Horace,

21, Linden Mansions, Highgate, N.

Pharmacist and Instructor in Pharmaceutical Chemistry and Pharmacy at Guy's Hospital. Associate of the Institute of Chemistry. Joint Author with Dr. John Wade of "Influence of Moist Alcohol and Ethyl Chloride on the Boiling Point of Chloroform," *Trans.*, 1904, **85**, 938—949.

Author of "Spurious Virginian Prime Barks," *Pharmaceutical Journal*, Mar. 12th, 1904.

Late Demonstrator in Chemistry in the Pharmaceutical Society's School.

Thos. Stevenson.
John Wade.

Arthur Lapworth.
J. Norman Collie.

W. Palmer Wynne.

Glass, Archibald Melville,

73, Roderick Road, Hampstead, N.W.

Patent Agent, B.Sc. London (Honours in Physics). Engaged in technical patent work requiring chemical knowledge. Was technical adviser for 2 years to a company manufacturing secondary batteries.

Studied chemistry under Professor Meldola at the Finsbury Technical College, and Dr. J. E. Mackenzie at Birkbeck College.

Alfred F. Joseph.
R. Meldola.
John Castell-Evans.
F. Henry Streatfeild.
John E. Mackenzie.

Gorman, Henry Isaac,

126, Quay, Waterford.

Pharmaceutical Chemist. Formerly a student under Professor Tichborne (F.I.C.), Dublin. Desires admission to the Society in order to keep in touch with recent work in Chemistry.

Harold W. Harrie.
Ernest J. Parry.
Henry Boyers.
Chas. R. C. Tichborne.
Thomas Tyrer.
J. H. Coste.
Thomas Morson.

Green, Ernest,

113, Hulton Street, Moss Side, Manchester.

Science Teacher. Since 1890, Organising Science Master to the Salford School Board, who wishes to obtain the literature of the Chemical Society.

W. B. Hards.
B. Prentice.
E. Clark.
J. R. Appleyard.
Wm. Scholes.
Francis Jones.
James Walker.
John S. Lumsden.

Griffiths, John,

The Hollies, Upton Park, Chester.

Teacher. Graduate in Science, University of Wales. Science Master at The College, Cleobury Mortimer. Attended Chemistry (Theory and Practical) courses at University College of North Wales from October, 1899, until June, 1903.

James J. Dobbie.
Alexander Lauder.
Allan Baguley.
Robt. D. Abell.
W. F. Lowe.
W. F. J. Shepheard.
John Bairstow.

Groves, Samuel Ernest,

10, Melrose Avenue, Monkseaton, Northumberland.

Works Chemist. Passed the advanced examination in theor. chemistry and the Honours examination in practical chemistry of the Board of Education in 1901. From 1901 to 1903 engaged in analytical and research work in the Chemical Laboratory, King's

College, London. Since December, 1903, as Analyst and Assistant Manufacturing Chemist to Messrs. Holzapfels, Newcastle-on-Tyne.

John M. Thomson.	Patrick H. Kirkaldy.
Herbert Jackson.	A. K. Huntington.
D. Northall Laurie.	

Hawthorne, John,

7, Roseneath Villas, Military Road, Cork.

Demonstrator, Queen's College, Cork. "On Ulva Latissima and its connection with Sewage Pollution." Letts and Hawthorne, *Proc.* R.S.E., 1900. "Ueber ein viertes Methylmorphimethin." Knorr and Hawthorne, *Ber.*, 1902. Junior Fellow in Chemistry, Royal University of Ireland.

Augustus E. Dixon.	Edmund Albert Letts.
W. E. Adeney.	J. Norman Collie.
William Ramsay.	

Hetherington, Arthur Lonsdale,

Government Collegiate School, Rangoon.

Principal of the Government College School at Rangoon, Burma. 2nd Class in the Natural Sciences Tripos, Cambridge, in June, 1903. Chemistry Master at Highgate School since October, 1903.

R. H. Adie.	George Dixon.
S. Ruhemann.	*M. Kelway Bamber.*
Charles T. Heycock.	*T. B. Wood.*

Howgate, James Henry, B.A. (Lond.),

The Avenue, Bakewell, Derbyshire.

Science Master, Lady Manners School, Bakewell. Teacher of Chemistry with management of Laboratories. Fifteen years' experience. Desirous of having the Society's Journals.

C. Jodrell Mansford.	Frank Dixon.
Samuel Fenton Stoll.	A. L. B. Tindall.
Harold E. Richardson.	

Kay, Sydney A.,

72, Market Street, St. Andrews.

Lecturer and Demonstrator in Chemistry, University of St. Andrews. Studied Chemistry at University College, Dundee, under Prof. P. F. Frankland, F.R.S., and Prof. J. Walker, F.R.S., 1893—97. D.Sc. (St. Andrews), 1902. Held "1851 Exhibition" Scholarship 1897—99, one year at Stockholm under Prof. Arrhenius, one year at Leipzig under Prof. Ostwald. Private Assistant to Prof. T. Purdie, F.R.S., St. Andrews, 1899—1900. University Assistant since 1900. Published work: "Equilibrium between Sulphuric Acid and Sulphates in

Aqueous Solution" (*Proc.* R. S. Edin.). With Prof. Walker, "On the so-called 'Hypoiodite of Magnesium'" (*Proc.* R. S. Edin.), and "Velocity of Urea Formation in Aqueous Alcohol" (*Trans. Chem. Soc.*).

Thomas Purdie.	Alex. Findlay.
James Walker.	Alex. McKenzie.
Percy F. Frankland.	Frank W. Young.

Killby, Leonard Gibbs,
10, Aberdeen Park, Highbury, London, N.

B.A. (Oxon). Scholar of New College, Oxford. First Class Honours in Chemistry—Honour School of Natural Science—June, 1904. Now Demonstrator in the Laboratory at Christ Church, Oxford, and engaged in research there.

H. Brereton Baker.	W. W. Fisher.
Alexander Scott.	R. C. T. Evans.
Allan F. Walden.	Charles E. Cassal.

Leek, William Henry,
Elm View, Leigh, Lancashire.

Head Master, Leigh Grammar School since 1895. (Graduate B.A., Univ. of London, 1889.) Teacher of Chemistry for South Kensington Exams. (Advanced and Honours). Teacher of Chemistry for Lancs. County Council Science Schools. Intermediate B.Sc. Exam., London, 1892. Worked for two years in the intervals of school duties in the Laboratory of the Borough Analyst of Bolton, 1897—1899. Is anxious to keep in touch with the results of modern research. For 1½ years worked under the direction of Rev. G. C. Chambres, Headmaster of Wigan Grammar School.

Walter Ratcliffe.	G. Crewe Chambres.
H. Lloyd Snape.	J. Parry Laws.

W. B. Hards.

Lewis, Ernest Isaac,
Felsted School.

Schoolmaster. Chemistry Master, Felsted School, 1903—1905. Chemistry Master, Oundle School, 1905— . 1st Class Natural Sciences Tripos, Part I. B.A., 1902, Cambridge. B.Sc., London. Formerly Scholar of Gonville and Caius Coll., Camb.

R. S. Morrell.	H. O. Jones.
M. M. Pattison Muir.	A. E. Bellars.
H. J. H. Fenton.	*W. J. Sell.*

Maguire, Peter,

Hamar House, Rochdale, Lancs.

Chemist Colorist. Studied Chemistry for four sessions under Mr. W. Marshall, F.I.C., F.C.S., at the Rochdale Municipal Technical Schools, 1895—1898. Certificates, South Kensington Organic and Inorganic Chemistry. Medallist, City and Guilds London Institute in Cotton Dyeing. Late Works Manager, Marland Dyeing Co., Heap Bridge, Lancs. At present as Head-dyer and Chemist, in charge of the dyeing and bleaching departments of Mr. John Wilkinson, Park Mill, Skipton, Yorks.

William Marshall. W. H. Pennington.
James H. Kershaw. *Walter M. Gardner.*
A. G. Green.

Marle, Ernest Robert,

135, Le Marchant Road, S. John's, Newfoundland.

Science Lecturer. Assoc. R.C.S., B.Sc. Lond.

William A. Tilden. Chapman Jones.
M. O. Forster. James C. Philip.
George T. Holloway.

Martin, Francis Grimshaw,

King Henry VIII. School, Coventry.

Schoolmaster. Science Master at Tavistock Grammar School from Sept., 1896, to Xmas, 1899. From Jan., 1900, until Xmas, 1904, Science Master at Lucton School. At present Science Master at King Henry VIII. School, Coventry.

Frank B. Gatehouse. *W. de W. Abney.*
G. Percy Bailey. *Thomas Tickle.*
A. Louis Robinson. *Robert Wright.*

Morris, Edwin,

12, Dragon View, Harrogate.

Lecturer in Chemistry and Physics. Associate of the Royal College of Science (Physics). Associate of the Royal School of Mines (Metallurgy). Lecturer in Chemistry and Physics, Harrogate Technical School.

W. Gowland. G. T. Morgan.
M. O. Forster. W. H. Merrett.
James C. Philip.

Mortimer, Alfred,

Trinity College, Stratford-on-Avon.

Science Master. (1) B.A. Oxford. Final Honours School of

Chemistry, but was unable to be placed in the Honours list, having, owing to illness, exceeded the time limit. (2) A little research work in Organic Chemistry at the University Laboratory, Oxford, under the supervision of Mr. J. E. Marsh.

W. W. Fisher.	T. V. Barker.
H. L. Bowman.	R. de J. Fleming-Struthers.
J. E. Marsh.	

O'Farrelly, Alfons, M.A.,
3, Holles St., Dublin.

Lecturer on Organic Chemistry, Royal College of Science, Dublin. Junior Fellow of the R.U.I. and Examiner in Chemistry to the Intermediate Education Board. Studied in the Universities of Berlin, Leipzig and Paris with Professors van't Hoff, Ostwald and Moissan. Work published in the Annals of the Prussian Academy and in the *Comptes rendus*.

W. N. Hartley.	Edmund Albert Letts.
W. E. Adeney.	J. Norman Collie.
William Ramsay.	

Sarginson, William,
200, Cauldon Road, Stoke-on-Trent.

Science Teacher at the Municipal Secondary School, Hanley. B.Sc. (Vict.). Student in the Owens College for 3 years. Teacher of Chemistry in the Higher Grade School, Hanley. Wishes to obtain the latest chemical literature.

Harold B. Dixon.	William A. Bone.
W. H. Perkin, jr.	D. L. Chapman.
G. G. Quinn.	

Shedden, Frank,
5, Belvidere Road, Walsall.

B.Sc. London, F.I.C. Science Master, The Grammar School, Newchurch, near Manchester. Joint author of papers which appeared in the Society's *Trans.*, 1902 and 1903. Abstractor to *Jour. Soc. Chem. Industry* and *Science Abstracts.* Student at Mason College, Birmingham. Research Chemist four years Wellcome Chemical Research Laboratories, London.

Percy F. Frankland.	Frederick B. Power.
Alex. McKenzie.	H. A. D. Jowett.
T. Slater Price.	Frederic H. Lees.

Shepherd, Charles Stuart,

Worth Matravers Vicarage, Wareham, Dorset.

Clerk in Holy Orders. A Student at "The Bristol Laboratory at the Bristol Trade and Mining School" (The Precursor of the present "Merchant Venturers' Technical College"), under the late Mr. Thomas Coomber, F.C.S., and Professor Munro, D.Sc., F.C.S. After, passing the Examination of the Science and Art Department in Chemistry, Magnetism, etc., and attending the Lectures in Chemistry at King's College, London: held the position of Analytical Chemist at the Works of Messrs. Thomas Farmer & Co., London, Chemical Manure Manufacturers. Has since lectured on Scientific subjects under the Dorset County Council Technical Instruction Committee.

H. H. B. Shepherd.
John M. H. Munro.
Alan McMullen.
Ernest H. Cook.
Bernard Dyer.
R. J. Friswell.
Edward Kinch.

Speight, William Ewart,

Corporation Sewage Works, Deighton, Huddersfield.

Chemist and Manager of Sewage Works. For three years Student in Chemical Dept., Yorks College, Leeds. 5½ years Chemical Assistant, West Riding of Yorks. Rivers Board. Recently appointed Chemist at Huddersfield Corporation Sewage Works.

Arthur Smithells.
J. B. Cohen.
H. T. Calvert.
W. Lowson.
C. E. Whiteley.

Stennitt, Sydney Dockeray,

16, Richmond Terrace, Whitchurch, Salop.

Science Master. Grammar School, Whitchurch. B.Sc. (Vict.) Honours School of Chemistry. 1st Class 1901. M.Sc. 1904. Assistant Science Master at Newcastle, Staffs., 1902, 1903, 1904. Science Master at Whitchurch since September, 1904.

Harold B. Dixon.
W. H. Perkin, jun.
Wm. A. Bone.
D. L. Chapman.
Alfred Holt, jun.

Stevens, Edmund Henry,

Haw House, Rothbury, Northumberland.

Schoolmaster. Lecturer in Chemistry at Sharp's School, Rothbury.

G. Senior.
Wm. A. Knight.
W. B. Hards.
D. T. Richards.
T. W. Berry.
Jas. H. Haynes.

Stevens, Harold Blythen,
225, Oxford St., W.

Pharmaceutical Chemist. At present in charge of Messrs. John Bell and Co.'s manufacturing laboratory. Some time student at Nottingham University College (1896-99). Silver medallist in Chemistry, Dr. Muter's School of Pharmacy. Joint author of two papers:—(1) Determination of Iron in Iron Pills. (2) Examination of Compound Tincture of Cardamoms. Now reading for London University degree. (Matriculated Jan., 1905).

F. Stanley Kipping.
Frank Clowes.
J. J. Sudborough.
R. M. Caven.
Walter Hills.
W. Palmer Wynne.

Swann, Robert Reed,
The Agricultural College, Aspatria, Cumberland.

Lecturer in Agricultural and General Chemistry at above College as above designated. B.Sc. (Dunelm), and formerly assistant in Agricultural Chemistry at Armstrong College, Newcastle-on-Tyne.

S. Hoare Collins.
F. C. Garrett.
P. Phillips Bedson.
F. O. Solomon.
J. T. Dunn.

Taylor, John William,
University College, Reading.

Analytical Assistant in the Agricultural Department, University College, Reading. Studied Chemistry and other Sciences, 1900—1903, and was student demonstrator in Chemistry, 1902—3. Have worked for 3 years at soil analysis under Dr. Luxmoore, and am at present studying for the London B.Sc. degree.

John Percival.
E. K. Hanson.
T. B. Wood.
C. M. Luxmoore.
J. W. Dodgson.
C. W. Walker-Tisdale.
Julien Drugman.

Thomas, George Devenish,
8, Hubert Terrace, Dover.

Science Master, Municipal Art, Science, and Technical Schools, Dover. Four years' experience as Senior Science Master, Dover Municipal Schools, 1901—1905. Five years' experience as Senior Sciences Master, Bath Technical Schools, 1896—1901. Four years Demonstrator in Chemistry and Biology, Merchant Venturers' Tech.

Coll., Bristol, 1892—1896. B.Sc. (Chemistry, Physics, and Botany) London.

J. Wertheimer.	James Leicester.
G. P. Darnell-Smith.	W. H. Pendlebury.

Ernest H. Cook.

Titherley, Arthur Walsh,

Southcot, Moreton, near Birkenhead.

Assistant Lecturer and Demonstrator, University of Liverpool. D.Sc. (Victoria); D.Sc. (Liverpool); Ph.D. (Heidelberg). Author of papers (1894—1904) in the *Journal* of the Chemical Society on Metallic Amides, Organic Substitution Derivatives of Sodamide: their uses in Synthesis; the Acylation of Amides; Furfurol Derivatives, &c.; and in the *Annalen* on Derivatives of Glutaric Acid.

J. Campbell Brown.	J. Norman Collie.
W. Collingwood Williams.	William Ramsay.

F. G. Donnan.

Wall, Francis Henry,

14, Hardman Street, Liverpool.

Chemist and Druggist. Senior Assistant, c/o Messrs. Symes & Co., Ltd., Manufacturing Chemists, Liverpool. Qualified Chemist, "Minor" Pharm. Society of Gt. Britain, Apothecaries' Hall, Blackfriars, London. Late Day Student, "Inorganic Chemistry," Bridgnorth Grammar School. Late Day Student, "Organic and Inorganic," Westminster College, London. Late Evening Student, "Organic Chemistry," Polytechnic Institute, London. Evening Student, "Metallurgy," University of Liverpool.

Albert E. Bell.	*J. Campbell Brown.*
Saml. Banner.	*W. Collingwood Williams.*
James Smith.	*Prosper H. Marsden.*

The following Certificates were authorised for presentation to Ballot by the Council under Bye-Law I (3):

Gillies, Albert,

Government Laboratories, Johannesburg, S.A.

Assistant Analyst and Assayer, Govt. Laboratories, Johannesburg. Four years' Chemical Training with W. A. Dixon, F.I.C., Sydney, N. S. Wales. Certificate from Sydney Technical College for Theoretical Chemistry. 14 months in present position in South Africa.

Walter C. C. Pakes.	W. H. Jollyman.

Maughan, Reginald Bruce,

Box 46, Bundaberg, Queensland, Australia.

Manager of the Bundaberg Co-operative Dairy Co., Ltd. Attended the Hawkesbury Agricultural College, Richmond, N. S. Wales, for 16 months as Outdoor Dairy Student, then joined the N.S.W. Fresh Food and Ice Co., Ltd., Sydney; was with the firm for 5½ years, the last 4 years or so was Analyst to the Coy., having 3 or more students as assistants. While with the Coy., attended Dairy Chemistry Classes at the Technical College for six months. Have been in my present position for over four years.

G. S. Thomson. John Joseph Eastick.
H. W. Potts. *J. C. Brünnich.*

Spencer, Arthur Gordon,

P.O. Box 554, Montreal, Can.

Analytical Chemist. Some Compounds of Aluminium Chloride with Organic Substances, Walker and Spencer, *Trans.* Chem. Soc. 1904, Vol. 85, pp. 1106–1110. B.Sc. 1904. McGill University, Montreal. Mem. Soc. Chem. Ind. Two years as a steel works chemist, also Chief Chemist Dominion Coal Co., Glace Bay, N.A. Chief Assistant to City Analyst of Montreal at present time.

J. Wallace Walker. B. J. Harrington.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 12/5/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 295.

Thursday, May 4th, 1905. Professor R. MELDOLA, F.R.S., President, in the Chair.

Mr. J. W. Wilkinson was formally admitted a Fellow of the Society.

A certificate was read for the first time in favour of Mr. Eric William Campbell, 97, Eaton Square, S.W.

A Ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

Arthur Amos, B.A.
Albert Edward Andrews.
John George Baxter.
Francis George Belton.
Edward Shipley Hewett Edwards Brettell-Vaughan.
Thomas Walter Firth Clark.
William Morris Colles, jun., B.Sc.
Miles Coup
Roger Dodds.
Sydney Dunstan.
Bernard Scott Evans, B.Sc.
John Greig Ferrier.
Frank Standish Findon, M.A , B.Sc.
Horace Finnemore.
Albert Gillies.
Archibald Melville Glass, B.Sc.
Henry Isaac Gorman.
Ernest Green.
John Griffiths, B.Sc.
Samuel Ernest Groves.
John Hawthorne.
Arthur Lonsdale Hetherington, B.A.
James Henry Howgate, B.A.
Sydney A. Kay, D.Sc.
Leonard Gibbs Killby, B.A.
William Henry Leek, B.A.
Ernest Isaac Lewis, B.A., B.Sc.
Peter Maguire.
Ernest Robert Marle, B.Sc.
Francis Grimshaw Martin.
Reginald Bruce Maughan.
Edwin Morris.
Alfred Mortimer, B.A.
Alfons O'Farrelly, M.A.
William Sarginson, B.Sc.
Frank Shedden, B.Sc.
Charles Stuart Shepherd.
William Ewart Speight.
Arthur Gordon Spencer, B.Sc.
Sydney Dockeray Stennitt, M.Sc.
Edmund Henry Stevens.
Harold Blythen Stevens.
Robert Reed Swann, B.Sc.
John William Taylor.
George Devenish Thomas, B.Sc.
Arthur Walsh Titherley, D.Sc., Ph.D.
Francis Henry Wall.

Of the following papers, those marked * were read :

*76. "Notes on sodium alum." By John Mello Wadmore.

The following experiment was made with the object of gaining information with regard to sodium alum, the existence of which was affirmed by Zellner, in 1816, and subsequently by Augé (*Compt. rend.*, 1890, **110**, 1139), but denied by Ostwald (*Principles of Inorganic Chemistry*, English edition, 1902, p. 556).

By mixing, in solution, quantities of sodium and aluminium sulphates in the proportion of their respective formula weights, a substance was obtained, crystallising in octahedra and having the appearance of an alum; moreover, the analytical data agreed closely with the numbers calculated for sodium alum, $Na_2SO_4,Al_2(SO_4)_3,24H_2O$.

The solubility of the compound was determined at various temperatures and found to be considerable. Thus, 1 gram of water at 10·6° dissolves 1·0711 grams of the crystalline salt.

Attention is drawn to the fact that a hot concentrated solution, on cooling, deposits a pasty or oily substance which is slowly transformed into crystalline sodium alum. This paste may possibly be a homogeneous mixture of anhydrous, or partly hydrated, alum and water.

Finally, it is shown that, whilst sodium alum does not effloresce appreciably under ordinary conditions, it rapidly parts with about half its water of crystallisation at 50°, but a higher temperature is needed to dehydrate it completely.

Discussion.

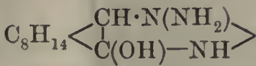
Dr. Morgan said that the author's results seemed to agree very closely with those already set forth in a recent patent (G. Dumont, D.R.-P. 141670, Abstr., 1903, ii, 547), both observers having noticed the formation of the intermediate amorphous substance followed by that of a crystalline, non-efflorescent alum.

Recently, in a preparation of *p*-benzoquinone, when a fairly concentrated solution of sodium dichromate was employed, he had noticed the production of large, well-defined crystals of sodium chrome alum, and he asked whether the author had made any experiments on the formation of this double salt.

Mr. Wadmore, in reply to a remark by Dr. Harden, said that there were several objections to the view that the paste might consist of anhydrous sodium sulphate, but admitted that the point required further investigation.

As to the possible existence of sodium chrome alum, he had already made some experiments in this direction, and hoped shortly to be able to furnish definite information.

*77. "Camphoryl-ψ-semicarbazide." By Martin Onslow Forster and Hans Eduard Fierz.

Camphoryl-ψ-semicarbazide,  $C_8H_{14}\Big<{CH\cdot N(NH_2) \atop C(OH)-NH}\Big>CO$, obtained by reducing camphorylnitroso-ψ-carbamide with zinc dust in dilute acetic acid, dissolves readily in water and crystallises from chloroform in minute, white needles melting at 193°; it has $[\alpha]_D$ 8·6°, and forms a definite *nitrate*, *cuprinitrate*, and *anhydride*.

Condensation with certain aldehydes and ketones takes place very readily, and many of the products have high specific rotatory power; the following cases are typical:

ψ-Semicarbazone.	M. p.	Solvent.	$[\alpha]_D$.	$[M]_D$.
m-Nitrobenzaldehyde .	218°	Acetic acid	+ 84°	301°
Acetone	217	Chloroform	− 188	498
Camphorquinone	234	,,	− 314	1172
Benzaldehyde............	223	,,	+ 421	1318
Furfuraldehyde	222	,,	+ 502	1522
Cinnamaldehyde	219	Ether	+ 605	2051
Benzoquinone	197	Acetone	− 1051	3310

The camphoryl-ψ-semicarbazones are characterised by the tenacity with which they retain solvent of crystallisation; this property accounts for the profound influence on specific rotatory power exerted by various media. The cinnamylidene derivative, for example, has the following values in the solvents mentioned:

Solvent.	$[\alpha]_D$.	Solvent.	$[\alpha]_D$.
Ether	+ 605°	Nitromethane	+ 307°
Chloroform...............	527	Acetone..................	162
Phenetole	451	Alcohol..................	107
Bromobenzene	438	Acetic acid	96
Carbon disulphide......	331	Pyridine	− 54

Similarly, the benzoquinone derivative has $[\alpha]_D$ − 1067° in chloroform and $[\alpha]_D$ − 545° in alcohol.

DISCUSSION.

Mr. W. ROBERTSON pointed out that the influence of the unsaturated linking on the rotation of optically active compounds was apt to be misinterpreted. The increase due to such a linking depends also on the position of the ethylenic bond; for example, Rupe has shown that menthyl caproate and menthyl hydrosorbate have almost identical specific rotatory power, although one is saturated and the other unsaturated. On the other hand, if the linking is close to the asymmetric complex, or to a phenyl group, the change in rotation is very marked.

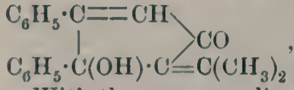
The President asked whether the compounds referred to by Dr. Forster as retaining their solvent of crystallisation with such obstinacy could be made to part with this attached solvent by heating, or whether they decomposed under this treatment. He congratulated the authors on having made what promised to be a most valuable addition to the agents available for the resolution of racemic neutral compounds such as aldehydes and ketones. The possible resolution of camphoryl-ψ-semicarbazide itself, referred to by Dr. Forster, had occurred to him also during the reading of the paper, and he suggested that some naturally occurring unsaturated open chain aldehyde possessed of optical activity, such as citronellal, might be found to answer the authors' requirements.

In reply to the President, Dr. Forster mentioned that the solvent of crystallisation is usually removed on prolonged exposure to a temperature approaching 100° without alteration on the part of the substances; attempts would be made to resolve the *pseudo*-semicarbazide on the lines suggested. He agreed with Mr. Robertson that the position of the unsaturated linking has influence on the rotation, but the series under consideration does not illustrate this point so clearly as Rupe's.

*78. "Some derivatives of anhydracetonebenzil."

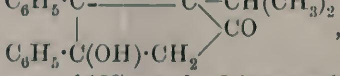
By Francis Robert Japp and Joseph Knox.

The condensation of benzil with unsaturated ketones has not hitherto been studied. The authors find that benzil interacts with methyl *iso*butenyl ketone, $CH_3·CO·CH:C(CH_3)_2$, under the influence of potassium hydroxide to yield β-iso*propylideneanhydracetonebenzil*,

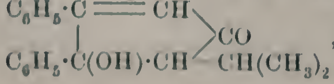


, slender, yellow needles (m. p. 205·5°).

With the corresponding saturated ketone, methyl *iso*butyl ketone, on the other hand, benzil condenses to form a mixture of α-iso*propyl-anhydracetonebenzil*,



, six-sided prisms or slender needles (m. p. 142°), and β-iso*propylanhydracetonebenzil*,

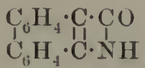


, flat needles (m. p. 161·5°).

*79. "The dihydrocyanides of benzil and phenanthraquinone. Second notice." By Francis Robert Japp and Joseph Knox.

The authors find that when benzildihydrocyanide is treated with cold concentrated sulphuric acid, it yields *diphenylacetamide*, $(C_6H_5)_2CH\cdot CO\cdot NH_2$ (m. p. 167·5—168°).

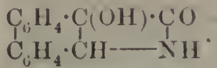
Japp and Miller (*Trans.*, 1887, **51**, 33) obtained, by the action of fuming hydrochloric acid on acicular phenanthraquinonedihydrocyanide, two compounds, $C_{15}H_9ON$ (m. p. 241°) and $C_{15}H_{11}O_2N$ (m. p. 183°). The present authors, from a study of the reactions of these compounds, assign to them the following constitutions :



$$\begin{array}{l} C_6H_4\cdot C\cdot CO \\ C_6H_4\cdot C\cdot NH \end{array}$$

Phenanthranil (m. p. 241°).

and



$$\begin{array}{l} C_6H_4\cdot C(OH)\cdot CO \\ C_6H_4\cdot CH\text{——}NH \end{array}.$$

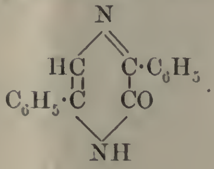
Hydroxydihydrophenanthranil (m. p. 183°).

Both compounds are capable of interacting also in the tautomeric form, and it is at present impossible to say whether the free substances are lactams, as here represented, or the corresponding lactims.

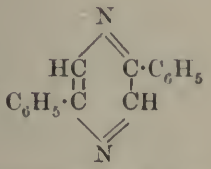
*80. "A condensation product of mandelonitrile." By Francis Robert Japp and Joseph Knox.

By saturating a solution of mandelonitrile in absolute ether with hydrogen chloride, Minovici (*Ber.*, 1899, **32**, 2206) obtained a compound, $C_{16}H_{12}ON_2$, for which he gives the melting point 200—203°.

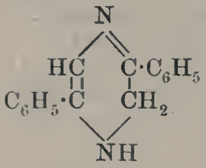
The authors show that this compound is identical with a substance melting at 196—197° previously obtained by Japp and Miller (*Trans.*, 1887, **51**, 29) by the action of hydrogen chloride on a solution of benzil in alcoholic hydrocyanic acid. They confirm the melting point given by Japp and Miller and regard the compound as 3-*keto*-2 : 5-*di*-*phenyl*-3 : 4-*dihydro*-1 : 4-*diazine*,



. By distillation with zinc dust, it yields 2 : 5-*diphenyl*-1 : 4-*diazine*,



(m. p. 194—195°), whilst by heating with hydriodic acid and red phosphorus it is reduced to 2 : 5-*diphenyl*-3 : 4-*dihydro*-1 : 4-*diazine*,



(m. p. 162—163°).

*81. "Action of hydrazine on unsaturated γ-diketones."

By Francis Robert Japp and James Wood.

C. Paal and Heinrich Schulze (*Ber.*, 1900, **33**, 3796) have shown that the *cis*- and *trans*-forms of *s*-dibenzoylethylene, $C_6H_5\cdot CO\cdot CH{:}CH\cdot CO\cdot C_6H_5$, may be readily distinguished from one another by the greater ease with which the *cis*-form interacts with hydrazine to form a 1 : 2-diazine.

The present authors have employed this reaction to ascertain the configurations of some analogous unsaturated γ-diketones: $\alpha\beta$-dibenzoylstyrene, dibenzoylstilbene, and α-benzoyl-β-trimethacetylstyrene. One result has been to confirm the configurations assigned to the different modifications of the two former compounds by Japp and Klingemann (*Trans.*, 1890, **57**, 667), namely:

	cis-Form.	*trans*-Form.
$\alpha\beta$-Dibenzoylstyrene	m. p. 129°	m. p. 197—198°
Dibenzoylstilbene	m. p. 220°	m. p. 232°

The *trans*-forms do not interact with hydrazine.

The only known form of α-benzoyl-β-trimethacetylstyrene (m. p. 115°) has the *cis*-configuration.

82. "The synthesis of substances allied to adrenaline."

By Henry Drysdale Dakin.

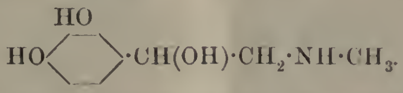
An account has recently appeared of the production of some compounds allied to adrenaline (D.R.-P. 157300; *Chem. Centr.*, 1905, i, 315), which have also been independently prepared by the author (*Proc. Physiol. Soc.*, 1905).

Methylaminoacetyl catechol, $C_6H_3(OH)_2\cdot CO\cdot CH_2\cdot NH\cdot CH_3$, which is obtained by the action of methylamine on chloroacetylcatechol (Stolz, *Ber.*, 1904, **37**, 4149), is crystalline and melts at 232°; it forms soluble crystalline salts which are perfectly stable. The solution of the salts are very faintly acid and the base is precipitated by sodium acetate. The base forms finely crystalline derivatives with phenylhydrazine acetate and with sodium hydrogen sulphite.

Natural adrenaline is generally assumed to be a secondary alcohol, whilst the above synthetical base is to be regarded as the corresponding ketone. On electrolytic reduction of the ketone or its bisulphite compound, a base is obtained which is probably not identical with racemic adrenaline. This product forms deliquescent crystalline salts (for example, the hydrochloride and oxalate), the solutions of which are practically neutral. The free base is not precipitated from a solution of its salts by sodium acetate. The hydrochloride gives a precipitate with potassium ferrocyanide on boiling and shows the usual colour reactions of catechol derivatives; it is unstable in hot aqueous solution, and is very readily decomposed by alkali even in the cold with evolution of methylamine. It has some physiological properties which are closely allied to those of adrenaline.

On addition of ammonia in slight excess to solutions of the salts, the free base is precipitated as a white, amorphous precipitate which is very sparingly soluble in most neutral solvents. The base may be kept for some little time suspended in water, but it is extremely unstable when dry, passing rapidly into a brown, insoluble substance with much less pronounced basic properties. This change may be analogous to that observed in the case of ω-aminoacetophenone. Owing to experimental difficulties, satisfactory analytical data and molecular weight determinations have not yet been obtained.

The preparation of a base which is probably identical with the substance just described is given in the above-mentioned German patent; this product is obtained by acting on methylaminoacetylcatechol sulphate with aluminium shavings in the presence of mercuric sulphate, and it is assumed to have the following constitution:



If this is correct, the formula for natural adrenaline will require modification, but the author is of opinion that the available evidence is insufficient to determine whether the synthetical base is a secondary alcohol or whether it possesses another of several possible alternative structures.

Homologous bases of similar chemical and physiological properties have been obtained by the electrolytic reduction of ketonic bases obtained by the action of various amines on chloroacetylcatechol.

83. "Methylation of *p*-aminobenzoic acid by means of methyl sulphate. Preliminary Note." By John Johnston.

By means of methyl sulphate, a practically quantitative yield of *p*-methylaminobenzoic acid may be obtained from *p*-aminobenzoic acid in presence of water. This compound is identical with that obtained by the action of methyl iodide on *p*-aminobenzoic acid, and melts at 144—145°. The melting point of the acid prepared by Houben (*Ber.*, 1904, **37**, 3978) is given as 228—229°, and the melting point of the acid prepared by Jaffé (*Ber.*, 1905, **38**, 1208) is given as 155—156°. Methyl *p*-methylaminobenzoate was prepared and melts at 75—76°.

p-Dimethylaminobenzoic acid was prepared by the further action of methyl sulphate on the monomethyl derivative; it melts at 235—236° and is identical with the product prepared by Michler (*Ber.*, 1876, **9**, 401).

The process of methylation cannot be carried further by means of methyl sulphate in aqueous solution, the best method for the preparation of the trimethyl derivative being that described by Michael and Wing (*Amer. Chem. J.*, 1887, **7**, 195).

84. "The atomic weight of nitrogen. Preliminary notice." By Robert Whytlaw Gray.

Many workers have pointed out that the atomic weight of nitrogen deduced by means of Avogadro's law from the relative densities of the pure gas and oxygen lies very near to the number 14·000 (Leduc, *Ann. Chim. Phys.*, 1898, [vii], **15**, 5).

When the two gases are compared under conditions in which this law may be considered to be strictly correct, the maximum value obtained lies below 14·010 (Guye, *Compt. rend.*, 1904, **138**, 1213; Rayleigh, *Phil. Trans.*, 1905, *A* **204**, 351).

The value 13·990 derived in a similar manner from nitrous oxide is also very close to these (Guye and Pintza, *Compt. rend.*, 1904, **139**, 677).

The researches of Stas, however, lead to a totally different number, namely, 14·055, and the two sets of experimental results, if accepted, lead to the conclusion that either (1) the law of Avogadro is not true for gases containing nitrogen, or (2) the relative weight of the atoms of nitrogen and oxygen is not a constant.

To throw light on this point, a careful study has been made of nitric oxide and the atomic weight of nitrogen has been deduced: (1) from the relative densities and compressibilities of nitric oxide and oxygen,

(2) from the decomposition of nitric oxide by means of finely divided nickel.

In an earlier notice (*Proc.*, 1903, **19**, 66) the weight of a litre of nitric oxide was stated to be 1·3402 grams under normal conditions (lat. Paris). Since then, a much more elaborate purification of the condensed gas has been carried out in order to free it absolutely from the last trace of nitrogen, and the mean of 10 new experiments gave 1·3406 grams for the weight of a litre at 0° and 760 mm. (lat. Paris).

On correction by means of Berthelot's formula, 30·005 was obtained for the molecular weight of the gas, and hence the value 14·005 for the atomic weight of nitrogen.

The accurate analysis of nitric oxide proved a matter of difficulty; iron wire absorbed only slowly all the oxygen and yielded traces of a gas condensable in liquid air which was probably cyanogen. With copper, the reaction was incomplete. Finally, it was found that the decomposition by means of finely divided nickel, discovered by Sabatier and Senderens (*Compt. rend.*, 1892, **114**, 1429), was an absolute one and capable of being carried out with great accuracy. Before an experiment, the nickel was heated to bright redness in a vacuum to expel hydrogen and traces of moisture.

The nitric oxide was decomposed in the same bulb in which it was weighed and the nitrogen was afterwards absorbed in a bulb containing charcoal and cooled in liquid air. In this way, a complete analysis of the gas was made. The nickel oxide was found to contain traces of nitrogen, which were only expelled after heating to redness in a vacuum for a considerable time.

Six experiments were made, and the mean value for the atomic weight of nitrogen was found to be 14·006. This number is possibly a little too low and more analyses are in progress.

85. "The methylation of gallotannic acid."

By Otto Rosenheim.

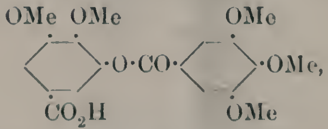
The rediscovery of the optical activity of gallotannic acid rendered untenable the generally accepted formula for digallic acid put forward by Schiff (compare Rosenheim and Schidrowitz, *Trans.*, 1898, **73**, 878 and 885, and *Proc.*, 1899, **14**, 67), as this configuration does not contain an asymmetric carbon atom. It was thought that the study of the methylation products of this substance and their subsequent hydrolysis might provide a clue as to its constitution. In view of the recent publication of Herzig and Tscherne (*Ber.*, 1905, **38**, 989), and as the author of the present communication is unable to continue the work, a short statement of the results already obtained seems justified.

It was found that methyl groups could be introduced into the gallotannic acid molecule with the greatest ease by means of methyl sulphate. In alkaline solution, the reaction takes place in the cold, and a white, amorphous substance is obtained, the yield being about 100 per cent. of the gallotannic acid. The product may be purified by pouring its alcohol or acetone solution into water; it begins to melt at 95—98° and is decomposed at a higher temperature, giving off carbon dioxide. It is insoluble in water, easily soluble in acetone, pyridine, or benzene, and resembles the parent substance in being dextrorotatory; a 2 per cent. solution in acetone shows a rotation of 20′ in a 100 mm. tube. The analytical data indicate the formula $C_{19}H_{20}O_9$, according to which the substance is a pentamethylgallotannic acid, but owing to the amorphous nature of the substance its purity cannot, as yet, be guaranteed, and the numbers obtained are only approximate.

The compound obtained by Herzig and Tscherne, by means of diazomethane, gave numbers agreeing with the formula $C_{25}H_{10}O_7(O{\cdot}CH_3)_8$ or $C_{24}H_8O_7(O{\cdot}CH_3)_8$.

From the products of acid hydrolysis, two optically inactive substances are isolated, which are both soluble in ether and may be separated by fractional crystallisation from water. The less soluble substance crystallises in long needles (m. p. 164°) and was recognised as trimethylgallic acid, whilst the more soluble compound, which was obtained in small, acicular crystals (m. p. 187°), was identified with the dimethylgallic acid prepared by Herzig and Pollak (*Monatsh.*, 1902, **23**, 700).

Assuming the validity of the old gallotannic acid formula, these results seem to agree with the following constitution:



which again, however, does not account for the optical activity of the substance.

86. "The interaction of hydrogen sulphide and sulphur dioxide." By William Robert Lang and Charles Macdonald Carson.

When hydrogen sulphide is passed into an aqueous solution of sulphur dioxide for several periods of from two to three hours on successive days, a milky solution is obtained which is termed Wackenroder's solution (Wackenroder, "On Pentathionic Acid," *Arch. Pharm.*, 1846, **48**, 272, 140; Berzelius, *Jahresbericht*, 1847 **27**, 36). This has been investigated by Debus (*Trans.*, 1888, **53**, 278), who proved the presence therein of sulphur, and sulphuric, trithionic, tetrathionic, and pentathionic acids, and probably hexathionic acid. The salts of these acids were examined by Hertlein (*Zeit. physikal. Chem.*, 1896, **19**, 287), who described methods for their separation and their physical properties. The explanation given by Debus for the formation of the polythionic acids is that tetrathionic acid is a direct product of the reaction of hydrogen sulphide on sulphurous acid, and that the other acids are formed from it by various subsequent reactions.

In order to investigate this, the reaction was effected, not in solution, but in the presence of a very little moisture, without which the gases do not interact. A large flask was surrounded with snow, a little moisture blown in, and the two gases then passed in at about equal rates for from two to three hours. A heavy yellow deposit, formed in the body of the flask, but not in the neck, was probably due to condensation of water having taken place only on the colder portions of the glass. This yellow material resembled ordinary sulphur, was dry to the touch, and quite brittle. On treatment with cold water, a milky liquid was obtained and the substance became stringy; this product, when boiled with water, was rendered soft and elastic.

Deposits formed by the above methods at different times, on being heated to 100° for an hour, lost from 25—30 per cent. by weight, and on estimating the sulphur compounds contained in them (as sulphuric acid) the amount never exceeded 1 per cent. Weighed quantities of the yellow material were allowed to remain in both open and closed tubes for several days at temperatures below 0°, but no change was noticeable in any case. When heated at 100°, the same loss of weight was observed as before; the presence of hydrogen sulphide could in no case be detected. Since the residue, after heating, contained more than 99 per cent. of free sulphur, it may be concluded that the polythionic acids were present in extremely small amounts.

Several quantities of the yellow material were next placed in stoppered bottles at the temperature of the room. After one day, the sulphur had become pliable and elastic and was covered with an oily liquid having an acid reaction, while a strong odour of sulphur dioxide was perceptible on removing the stoppers. The amount of this liquid seemed to increase after the second day, and this was proved to be the case on estimating the sulphuric acid present in quantities which had stood for one and two days respectively, and which had afterwards been heated at 100°. This liquid was then obtained in larger quantities, and was found to have a sp. gr. usually above 1·35, and to correspond with what is commonly called pentathionic acid, and which Debus showed to be a mixture of polythionic acids. Around the neck of the bottles, while below 0°, colourless crystals had formed: these were in such small amounts that their composition was not determined, although, on warming, they gave off sulphur dioxide and left a deposit of sulphur.

It would appear from the above experiments that the action of gaseous hydrogen sulphide on gaseous sulphur dioxide produces first sulphur and water according to the equation,

$$2H_2S + SO_2 = S_3 + 2H_2O,$$

with sulphur dioxide present in the sulphur in considerable quantities. The last two substances slowly interact at comparatively higher temperatures, giving rise to polythionic acids.

An attempt was made to investigate the action of anhydrous liquid hydrogen sulphide on liquid sulphur dioxide, but the drying of the gases was probably not thorough enough. About 5 c.c. of liquid hydrogen sulphide were collected in a thick-walled glass tube surrounded by a freezing mixture, dry sulphur dioxide passed in until the volume of the mixed liquids measured some 15 c.c., and the tube then sealed at the blowpipe. A slight yellow deposit was formed where the tube was sealed. After one day, a thin yellow film had formed at the upper part of the tube which gradually increased, and when the tube was opened after one week there was found in the bottom a solid lump of sulphur covered by a clear liquid. This liquid, when allowed to evaporate, gave off sulphur dioxide and left a small quantity of water containing dissolved sulphur dioxide.

Methods for the detection and estimation of the different polythionic acids which will, it is hoped, enable the composition of the oily mixture of acids to be accurately determined are at present being investigated.

87. "The formula of cyanomaclurin." By Arthur George Perkin.

Although cyanomaclurin bears a close relationship to catechin, $C_{15}H_{14}O_6$, and analyses of its derivatives were in harmony with the suggestion that it was isomeric with this substance (*Proc.*, 1904, 20, 171), it is now found by exhaustive analysis of the compound itself purified in various ways that the formula $C_{15}H_{12}O_6$ is to be preferred. Consequently its derivatives are to be represented as follows: acetyl cyanomaclurin, $C_{15}H_7O_6(C_2H_3O)_5$; benzoylcyanomaclurin,

$$C_{15}H_7O_6(C_7H_5O)_5;$$

benzeneazocyanomaclurin, $C_{15}H_{10}O_6(C_6H_5N_2)_2$, and acetylbenzeneazocyanomaclurin, $C_{15}H_7O_6(C_6H_5N_2)_2(C_2H_3O)_3$.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Blyth, Alexander Wynter, and Blyth, Meredith Wynter. Foods: their composition and analysis. With an introductory essay on the history of adulteration. 5th edition. pp. xxv + 616. ill. London 1903. (*Recd.* 19/4/05.)

Castell-Evans, John. Physico-chemical tables. Vol. I. Chemical engineering and physical chemistry. pp. xxxii + 548. London 1902. (*Recd.* 19/4/05.)

Collins, Henry F. The metallurgy of lead and silver. Part I. Lead. Part II. Silver. 2 vols. pp. xvi + 368, xvi + 352. ill. London 1899, 1900. (*Recd.* 19/4/05.)

Davis, George E. A handbook of chemical engineering, illustrated with working examples and numerous drawings from actual installations. 2nd edition. 2 vols. pp. xvi + 531, vii + 526. ill. London 1904. (*Recd.* 19/4/05.)

Findlay, Alexander. The phase rule and its applications, together with an introduction to the study of physical chemistry, by Sir William Ramsay. pp. lxiv + 313. ill. London 1904. (*Recd.* 19/4/05.)

Foster, Sir Clement Le Neve, and Haldane, J. S., *editors*. The investigation of mine air: an account by several authors of the nature, significance, and practical methods of measurement of the impurities met with in the air of collieries and metalliferous mines. pp. xii + 191. ill. London 1905. (*Recd.* 19/4/05.)

Julian, H. Forbes, and Smart, Edgar. Cyaniding gold and silver ores. A practical treatise on the cyanide process. pp. xx + 405. ill. London 1904. (*Recd.* 19/4/05.)

Lehfeldt, R. A. Electro-chemistry. Part I. General theory. Including a chapter on the relation of chemical constitution to conductivity, by T. S. Moore. pp. ix + 268. ill. London 1904. (*Recd.* 19/4/05.)

Lunge, George. Coal-tar and ammonia. 3rd edition. pp. xvi + 929. ill. London 1900. (*Recd.* 19/4/05.)

Mellor, J. W. Chemical statics and dynamics, including the theories of chemical change, catalysis, and explosions. pp. xiv + 528. London 1904. (*Recd.* 19/4/05.)

Redgrave, Gilbert R., and Spackman, Charles. Calcareous cements: their nature, manufacture, and uses, with some observations upon cement testing. 2nd edition. pp. xviii + 310. ill. London 1905. (*Recd.* 19/4/05.)

Young, Sydney. Fractional distillation. pp. xii + 284. ill. London 1903 (*Recd.* 19/4/05.)

III. *Pamphlets.*

Mingaye, John C. H. Notes on, and analyses of, the Mount Dyrring, Barraba, and Cowra meteorites. (From the *Records Geol. Survey, N.S. Wales*, 7, 1904.)

Mingaye, John C. H., and White, Harold P. Analyses of leucite basalts, &c., and olivine basalts from New South Wales. (From the *Records Geol. Survey, N.S. Wales*, 7, 1904.)

Shaw, G. W. California olive oil; its manufacture. (Univ. of California, College of Agriculture Bulletin, No. 158.) Sacramento 1904.

Twight, E. H., and Ash, Charles S. Contribution to the study of fermentation. (Univ. of California, College of Agriculture Bulletin, No. 159.) Sacramento 1904.

Waidner, C. W., and Burgess, G. K. Optical pyrometry. (From the *U.S. Bureau of Standards, Bulletin No.* 2, 1905.)

Woods, C. D., and Mansfield, E. R. Studies of the food of Maine lumbermen. (U.S. Dept. of Agric. Office of Experiment Stations, Bulletin No. 149.) Washington 1904.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 5th, 1905.

At the next Meeting, on **Wednesday,** May **17th,** 1905, at **5.30.** p.m., the following papers will be communicated:

"The chlorination of methyl derivatives of pyridine. Part I. 2-Methylpyridine." By W. J. Sell.

"The absorption spectra of uric acid, murexide, and the ureides in relation to colour and to their chemical structure." By W. N. Hartley.

"Further studies on dihydroxymaleic acid." By H. J. H. Fenton.

"The thermal decomposition of formaldehyde and acetaldehyde." By W. A. Bone and H. L. Smith.

"The synthesis of formaldehyde." By D. L. Chapman and A. Holt, jun.

"The influence of light on diazo-reactions. Preliminary notice." By K. J. P. Orton, J. E. Coates, and, in part, F. Burdett.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/5/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 296.

Wednesday, May 17th, 1905. Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. D. L. Chapman and A. E. Bellars were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Edward Williams Bealey, B.A., 55, Belsize Park Gardens, Hampstead, N.W.
William James Bees, B.Sc., 43, Ash Grove, Hyde Park, Leeds.
William Robert Bousfield, M.A., K.C., St. Swithin's, Hendon.
William Beaverly Cowie, 26, East Claremont Street, Edinburgh.
William Walpole Day, B.Sc., Ellerslie, Harrogate.
Herbert Henstock, B.Sc., Feldeggstrasse 33, Zürich V, Switzerland.
William John Jarrard, B.Sc., 41, Whittingstall Road, Fulham, S.W.
Arthur Walter Mason, B.Sc., 6, Northumberland Place, North Shields.
Frederick Wilson Montrose Ross, 21, Soho Square, W.
James Steger, B.Sc., 111, Chesterfield Road, Bristol.
William Bradshaw Tuck, University College, Gower Street, W.C.
John William White, 9, Hampden Place, Halifax, Yorks.
William James Wren, 271, Park Road, Oldham.

Of the following papers, those marked * were read :

*88. "The desmotropic form of substances of the ethyl acetoacetate type in the homogeneous state and dissolved in neutral media.'

By Julius Wilhelm Brühl and Heinrich Schröder.

The authors claim to have established by strict proof that both the primary ethyl acetoacetates and their secondary and tertiary alkyl substitution products, and also the camphorcarboxylic esters and their alkyl derivatives, although liquid, display a pure uniform ketonic structure and contain no traces of tautomeric enolic structures, which can be demonstrated by experiment.

The following table gives, firstly, the spectro-chemical molecular functions of ethyl acetoacetate when dissolved in water, methyl alcohol, or chloroform; secondly, the constants of the homogeneous undissolved ester, and finally those of the ester dissolved in ethyl-alcoholic sodium ethoxide.

Ethyl acetoacetate.	Percentage of ester dissolved.	$\left(\frac{n^2-1}{n^2+2}\right)\frac{P}{d} = M.$		
		M_α.	M_D.	$M_\gamma - M_\alpha$.
Dissolved in water	6·960 8·895	31·61 31·66	31·76 31·82	0·77 0·79
Dissolved in methyl alcohol	30·20 56·68	31·87 31·83	32·05 31·98	0·89 0·86
Dissolved in chloroform ...	22·50 44·61	31·93 31·89	32·11 32·05	0·90 0·88
Homogeneous.....	100·0	31·80	31·96	0·87
Dissolved in 12·68 per cent. sodium ethoxide	19·29	35·38	35·77	2·45

The table indicates, moreover, that the functions of the dissolved ethyl acetoacetate obtained from all solutions in neutral media are practically identical (compare *Ber.*, 1905, 38, 1868).

Discussion.

Mr. Baly asked Professor Brühl whether he had investigated the compounds under the influence of ultra-violet light. According to experiments on the ultra-violet absorption spectra by Dr. Desch and himself, it appeared that the metallic derivatives in alkaline or neutral solvents are equilibrium mixtures of the two tautomeric forms. It seems probable from these and some later results that the more stable condition of the metallic derivatives is the enolic form, and that under the influence of the ultra-violet light some of the ketonic modification is formed, and an equilibrium between the two forms is set up.

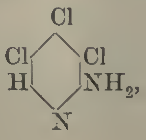
Professor Brühl, in reply to Mr. Baly, said that he had not investigated aqueous solutions of the sodium derivative of ethyl acetoacetate, but had only examined the substance dissolved in the alcohols. Aqueous solutions are partly hydrolysed and must therefore contain both the free ketonic ethyl acetoacetate and the enolised sodium derivative. On the other hand, solutions of this derivative in the anhydrous alcohols are not at all hydrolysed, and they contain only a single form, namely, the enolic one.

He also pointed out that Mr. Baly worked in very dilute solutions, and under these conditions the chemical relations would differ from those obtaining in the concentrated solutions used by himself and Schröder.

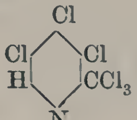
It is also possible that the very energetic ultra-violet light used by Mr. Baly exerts some action on the solutions of substances capable of being tautomerised.

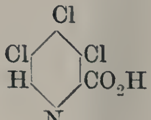
*89. "The chlorination of methyl derivatives of pyridine. Part I. 2-Methylpyridine." By William James Sell.

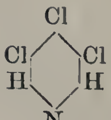
When 2-methylpyridine is subjected to the action of a current of chlorine, the molecule for the most part breaks down and a tarry mass is produced, a similar result being obtained on heating the methylpyridine with phosphorus pentachloride. In these circumstances, recourse was had to the process found successful in the case of pyridine, namely, the chlorination of the hydrochloride saturated with hydrochloric acid. The only solid substance as yet produced as the direct result of chlorination separates as a white, crystalline powder having the formula C_6HCl_6N. This compound is resolved by gently heating with 80 per cent. sulphuric acid into a trichloropicolinic acid, which, on heating with glycerol, gives a trichloropyridine (m. p. 72—73°). Since this trichloropicolinic acid is convertible through its amide by the Hofmann reaction into a trichloroaminopyridine identical with the substance which has been shown (*Trans.*, 1899, **75**, 980; 1900, **77**, 771) to have the constitution represented by the formula



it is clear that the three foregoing substances may be thus represented :


I.


II.


III.

Discussion.

Sir William Ramsay asked whether Mr. Sell had investigated a compound obtained by the action of chlorine on picoline, having a smell of bleaching-powder.

Mr. Sell, in reply, said he had often noticed the substance referred to, but had hitherto found no opportunity of making more than a cursory examination of it. This product is not noticed during the chlorination of picoline hydrochloride, but only when the free base is used.

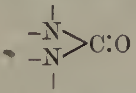
*90. "The absorption spectra of uric acid, murexide, and the ureides, in relation to colour, and their chemical structure."

By Walter Noel Hartley.

The author refers to a former paper (*Trans.*, 1887, 51, 153) of which this is a continuation. He found it necessary to examine the chemical constitution of murexide, and had made considerable progress in this direction, when work on similar lines was published almost simultaneously by Piloty (Abstr., 1904, i, 820), Möhlau (*ibid.*, p. 654), and Max Slimmer and Stieglitz (*ibid.*, p. 634).

Murexide was prepared from two sources, namely, alloxantin and alloxan, by boiling with alcoholic ammonia for half an hour. Two intermediate products were obtained, the one being colourless with a rich blue fluorescence and a strong absorption band in the ultra-violet, the other a reddish-yellow substance which appears to be purpuric acid, the absorption spectra of which were photographed. The ureides, diureides, and some oxypurin derivatives were spectrographically examined. They are divided into two groups, those which show an absorption band and those which do not.

The former are those oximino-ketones with no ethylenic linking associated with the carbonyl groups. On the other hand, those which have one or more such linkings do show bands; other substances, such as alloxantin and dialuric acid, are capable of undergoing a change under the action of water, and these exhibit a band, that of dialuric acid, being identical with that of alloxantin. Others apparently occur in isodynamic forms, the change being rendered evident by the development of a band in a solution which at first shows none. Theobromine and caffeine are examples. Whether the substance shows an absorption band or not is apparently determined by the 8th position in the purin ring being occupied by O, OR (where R is an alkyl or monad metal), or by H.



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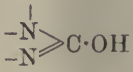
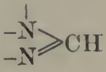
2 : 6 : 8-Oxypurin



$\begin{matrix} | \\ -N \\ -N \end{matrix} \geqslant C{\cdot}OH$

2 : 6-Oxypurin

show spectra with a band.



$\begin{matrix} | \\ -N \\ -N \end{matrix} \geqslant CH$

6-Oxypurin shows no band.

*91. "Observations on chemical structure and physical properties associated with the theory of colour." By Walter Noel Hartley.

Owing to certain peculiarities in the absorption spectra of the ureides, the author collates a number of observations on the structure of chromogenic compounds, together with various views regarding the origin of colour in dyes and other substances. Selecting that feature which is common to them all, he seeks to apply it to an explanation of the absorption phenomena generally observed in the aromatic hydrocarbons and their derivatives. The main feature in a coloured substance is the occurrence in two parts of the molecule of ethylenic and benzenoid groupings and of ketonic groupings. The ethylenic and ketonic groupings in a molecule are precisely those admitting of a keto-enolic isodynamic change, which, in accordance with the view of Baly and Desch (*Trans.*, 1904, **85**, 1029), is the cause of selective absorption. According to J. Schmiedlin (*Compt. rend.*, 1904, **139**, 872), the two parts of the molecule of a dye must consist of one endothermic and the other exothermic, the former being chromophoric, the latter an auxochrome. It is pointed out that benzenoid and ethylenic groupings are endothermic, whilst a carbonyl group is exothermic; and also that whilst azobenzene is a yellow chromogen, benzene is also a chromogen, but its colour is in the ultra-violet. The explanation based on the change from a double linking (ketonic) to a single linking (enolic) should, if sound, be capable of explaining the occurrence of six bands in the spectrum of benzene, four in that of naphthalene, and four in that of anthracene.

It is shown how this is possible from Kekulé's formula for benzene, and how this formula may be reconciled with the centric formula.

*92. "Further studies on dihydroxymaleic acid." By Henry John Horstman Fenton.

The mode of formation, properties, constitution, and relationships of dihydroxymaleic acid have been discussed in several previous communications (*Trans.*, 1894, **65**, 899; 1895, **67**, 48 and 774; 1896, **69**, 546; 1897, **71**, 375; 1902, **81**, 426; *Proc.*, 1898, **14**, 119; *Proc. Camb. Phil. Soc.*, 1901, **11**, 109; 1902, **11**, 358, &c.), and the present paper gives an account of some of the principal investigations which have since been carried out in connection with this subject.

Results of considerable interest have been obtained from a study of the condensation of the acid with ammonia and the behaviour of the acid and its esters towards various hydrazines. Further observations have been made on the conditions of formation of glycollic aldehyde and of mesoxalic semi-aldehyde, and the properties of the latter substance have also been further examined.

*93 "The influence of light on diazo-reactions. Preliminary notice." By Kennedy Joseph Previté Orton and Joseph Edward Coates and (in part) Frances Burdett.

Although it has long been realised that certain diazo-compounds are sufficiently sensitive to light to render a "diazo-type" photographic process practicable (Feer, D.R.-P. 53455; Green, Cross, and Bevan, D.R.-P. 56606, *Ber.*, 1890, **23**, 3131, and *J. Soc. Chem. Ind.*, 1890, **9**, 1001; and Ruff and Stein, *Ber.*, 1901, **34**, 1668), the precise reactions involved do not appear to have been fully investigated. The experiments appear to have been carried out exclusively with solid diazo-compounds. Green, Cross, and Bevan (*loc. cit.*, and *Ber.*, 1901, **34**, 2495) state that the primary action of light is to effect a decomposition into phenols and nitrogen.

In the case of the highly substituted diazobenzenes, which are quite stable at the ordinary temperature, the effect of light as an accelerator of certain reactions can be easily studied. The reactions are well illustrated in the remarkable behaviour of *s*-tribromodiazobenzene. On boiling aqueous or acid solutions of *s*-tribromobenzenediazonium salts, no *s*-tribromophenol is formed (Silberstein, *J. pr. Chem.*, 1883, [ii], **27**, 113; Hantzsch, *Ber.*, 1900, **33**, 2517). It has been shown, on the contrary (Orton, *Trans.*, 1902, **83**, 802), that the chief reaction is the elimination of bromine and the formation of dibromoquinonediazide. When aqueous solutions of the diazonium salts are exposed to sunlight, a rapid decomposition into *s*-tribromophenol and nitrogen occurs. The addition of acid has no retarding effect on the rate of the decomposition, but rather increases the yield of *s*-tribromophenol. In the absence of excess of acid, a secondary reaction, the elimination of bromine and the formation of quinonediazide, becomes noticeable (compare Orton, *loc. cit.*).

The corresponding *s*-tribromobenzenediazotates, on the other hand, are entirely unaffected by sunlight.

Not only are the solutions in water very sensitive to light, but also the solutions in methyl and ethyl alcohols and acetic acid are similarly easily decomposed. *s*-Tribromobenzenediazonium salts are remarkable in that their solutions in methyl and ethyl alcohols and in acetic acid yield, on boiling, only *s*-tribromobenzene, and no *s*-tribromoanisole, *s*-tribromophenetole, or *s*-tribromophenyl acetate respectively. In the decompositions effected by sunlight, on the other hand, the main product of the reaction is the methyl or ethyl ether, the anisole, $C_6H_2Br_3 \cdot OMe$, and the phenetole, $C_6H_2Br_3 \cdot OEt$, when methyl or ethyl alcohol are the solvents. The solution in acetic acid yields *s*-tribromophenyl acetate, $C_6H_2Br_3 \cdot OAc$. That the light has a specific accelerating influence on these particular decompositions, is shown by the fact that a solution of the diazonium sulphate in 90 per cent. alcohol, which slowly decomposes at the ordinary temperature, yields only *s*-tribromobenzene in the absence of light, but a large proportion of the phenetole when exposed to sunlight. A solution of potassium *s*-tribromobenzenediazotate in methyl alcohol is unaffected by light. The presence of acids and of water in the alcoholic solution has a marked effect on the course of the reaction.

A number of diazonium salts and diazotates have been investigated, similar effects being observed in each case. Solutions of diazonium salts have been kept for many weeks (10) in the dark without the evolution of a measurable volume of nitrogen; on exposure to sunlight, a rapid change into the corresponding phenol ensues. An interesting example is found in the case of 5-bromo-*m*-xylene-4-diazonium hydrogen sulphate, which is quite stable in aqueous solution at the ordinary temperature so long as light is excluded, but decomposes rapidly either on exposure to light or on heating into the corresponding xylenol.

The results lead the authors to conclude that the conversion of diazo-compounds into phenols, ethers, and phenylacetates is a reaction characteristic of the diazonium ion.

DISCUSSION.

Dr. CAIN congratulated Professor Orton on having discovered a method of obtaining certain phenols from the corresponding diazo-salts, which in many cases did not undergo the usual decomposition on boiling with either dilute or strong acids. He took exception, however, to Dr. Orton's statement that the diazo-salt from *s*-tribromoaniline yielded no phenol when boiled with acids, for although several observers had also recorded their failures to detect any tribromophenol, he had, by adopting the method described in D.R.-P. 95339, which consisted in dropping the diazo-solution into a boiling mixture of sodium sulphate and dilute sulphuric acid, succeeded in obtaining a small yield (2 per cent.) of tribromophenol. He had also noticed that a solution of benzenediazonium chloride on exposure to sunlight deposited a thick, brownish-yellow precipitate in a very short time, whilst another portion of the same solution kept in the dark remained perfectly clear.

Professor ORTON, in reply, said that they had failed to obtain *s*-tribromophenol by Heinichen's method (*Annalen*, 1889, **253**, 281), namely, by heating with 63 per cent. sulphuric acid (b. p. 150°), but they had not tried heating in a concentrated solution of sodium sulphate.

*94. "Behaviour of solutions of propyl alcohol towards semipermeable membranes." By Alexander Findlay and Frederick Charles Short.

Some years ago, S. U. Pickering stated (*Ber.*, 1891, **24**, 3639) that when a porous pot containing a 57 per cent. aqueous solution of propyl alcohol was immersed in either pure water or pure propyl alcohol, the water or the alcohol passed inwards to the solution. Pickering, therefore, ascribed osmotic pressure to the permeability of the membrane for either of the pure components and its impermeability for the hydrate formed in the solution.

The authors have sought, with the use both of porous pots and of copper ferrocyanide membranes, to repeat Pickering's experiments, but they have in no case obtained any indication confirmatory of this observer's results. When simple porous pots were used, the level of the liquid in the manometer tube attached to the porous pot fell in each case, no matter whether the surrounding liquid was water or propyl alcohol. When a copper ferrocyanide membrane was employed, a rise of liquid in the manometer tube was obtained when the pot was surrounded by water, but a fall occurred when the pot was placed in propyl alcohol.

It is conceivable that the behaviour observed by Pickering might be due to differences in the velocity of diffusion of the pure liquids and the solution, but in this case the rise of liquid obtained could only have been temporary, and the experiment would then lose all its significance for the problem of solution.

DISCUSSION.

Mr. PICKERING stated that he could give no further details of his experiment than those which had already been published. There appeared to be no doubt as to the fact observed by him, for the observation was repeated several times. The porous pot used had no semipermeable diaphragm, but it was only in the case of comparatively impervious pots that the phenomena were apparent; if the pot was too porous, the excess of pressure was not maintained. The result might have been due to ordinary diffusion, but that would not invalidate the explanation given of it.

Dr. FINDLAY, in reply, said that it would appear that the rise of liquid which Professor Pickering had observed in the manometer was only a temporary one, and that, consequently, the explanation which the authors offered of the discrepancy between the two results is the correct one.

95. "The thermal decomposition of formaldehyde and acetaldehyde." By William Arthur Bone and Henry Llewellyn Smith.

The authors show that at all temperatures between 400° and 1125° formaldehyde rapidly decomposes, without any separation of carbon, in accordance with the equation $CH_2O = CO + H_2$, and that the decomposition is not, to any appreciable extent, reversible. At high pressures (concentrations), the simple decomposition may be masked by more complex changes.

At 400°, acetaldehyde decomposes without any separation of the carbon or liberation of hydrogen, in accordance with the equation $CH_3{\cdot}CHO = CH_4 + CO$, but at 600° and higher temperatures carbon and hydrogen appear among the products. The effect of a hot surface of porous porcelain, at 450—500°, on the undiluted aldehyde vapour, in absence of oxygen, is to induce the "aldol condensation" with formation of crotonaldehyde and steam.

96. "The synthesis of formaldehyde." By David Leonard Chapman and Alfred Holt, jun.

The authors have succeeded in synthesising formaldehyde by maintaining a platinum wire at a high temperature in the following mixtures: (*a*) carbon monoxide and hydrogen; (*b*) carbon monoxide, hydrogen, and steam; (*c*) carbon monoxide and steam; (*d*) carbon dioxide and hydrogen. All attempts to obtain formaldehyde in appreciable quantities by passing the same gaseous mixtures through heated tubes at temperatures below 500° were unsuccessful.

97. "Oxymercuric perchlorates and the action of alcohol on mercury perchlorates." By Masumi Chikashigé.

Three new oxymercuric perchlorates are described, making four altogether, with that previously described (*Proc.*, 1895, **11**, 164). (1) *Hydrated oxymercuric perchlorate*, $OHg_3(ClO_4)_4,12H_2O$, crystallising from its cold aqueous solution and decomposing in its boiling solution; (2) the same salt, that is, $\frac{1}{3}$-*basic oxymercuric perchlorate*, rendered anhydrous by boiling alcohol and thereby greatly altered in stability; (3 and 4) two isomeric $\frac{2}{3}$-*basic oxymercuric perchlorates*, $O_2Hg_3(ClO_4)_4$, differing greatly from each other, although both are anhydrous. The α-salt, described in the previous paper, is non-explosive, whereas the β-salt, obtained by heating the $\frac{1}{3}$-basic salt in boiling alcohol, is a powerfully detonating substance.

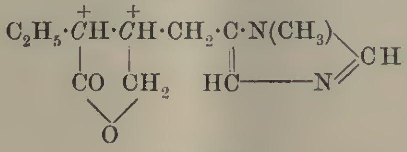
Mercuric perchlorate interacts with boiling alcohol to form mercurous perchlorate, perchloric acid, and aldehyde. The $\frac{1}{3}$-basic salt is partly reduced to mercurous salt by boiling with alcohol, and partly decomposes into perchloric acid and the β-$\frac{2}{3}$-basic oxymercuric salt (insoluble in acids). No reduction of perchloric acid occurs, and no trace of chloride is formed.

98. "The constitution of pilocarpine. Part V. Conversion of *iso*pilocarpine into pilocarpine." By Hooper Albert Dickinson Jowett.

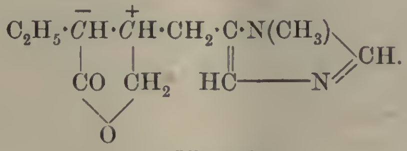
The author discussed the question as to the relationship between pilocarpine and *iso*pilocarpine, and showed that the evidence on the whole favoured the view that the alkaloids were stereoisomerides. The views of Pinner on this subject (*Ber.*, 1905, **38**, 1570), namely, that the isomerism is not solely stereochemical, but structural, were shown to be open to objection. It was shown that if the alkaloids were stereoisomerides, *iso*pilocarpine should be capable of conversion into pilocarpine by the same reagent which converts pilocarpine into *iso*pilocarpine, whereas if they were structural isomerides this conversion would not take place.

By heating pure *iso*pilocarpine, shown to be free from pilocarpine, with alcoholic potash, a mixture was obtained from which 80 per cent. of pure *iso*pilocarpine was separated, and from the mother liquors, after recrystallisation and conversion into the hydrochloride, a small quantity of pure pilocarpine was isolated. The identity of the latter was proved by the formation of the hydrochloride (m. p. 201°, $[\alpha]_D$ +92·8°) and of the nitrate (m. p. 177—178°).

It was thus shown that the alkaloids are almost certainly stereoisomerides, and may be represented by the following formula :



Pilocarpine.



*iso*Pilocarpine.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bloxam, W. Popplewell, and Leake, H. M., with the assistance of R. S. Finlow. An account of the research work in indigo, carried out at Dalsingh Serai Research Station (*under subsidy of the Government of Bengal*) from 1903 to March 1904. pp. 45 + lxxxix. Calcutta 1905. (*Recd.* 16/5/05.) From the Authors.

Meldrum, Andrew N. Avogadro and Dalton. The standing in chemistry of their hypotheses. With a preface by Francis R. Japp. pp. 113. Edinburgh 1904. (*Recd.* 17/5/05.) From the Author.

Russell, J. B., and Bell, A. H. Notes on volumetric analysis. pp. viii + 94. ill. London 1905. (*Recd.* 15/5/05.)
From the Publisher.

II. *By Purchase.*

Harbord, F. W. The metallurgy of steel. With a section on the mechanical treatment of steel, by J. W. Hall. Second edition. pp. xxiv + 768. ill. London 1905. (*Recd.* 11/5/05.)

Kayser, H. Handbuch der Spectroscopie. Band III. pp. viii + 604. ill. Leipzig 1905. (*Recd.* 1/5/05.)

Traube, J. Grundriss der physikalischen Chemie. pp. viii + 360. ill. Stuttgart 1904. (*Recd.* 8/5/05.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in June next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, June 5th, 1905.

At the next Meeting, on **Thursday**, June **1st**, 1905, at **8** p.m., the following papers will be communicated:

"The constituents of the seeds of *Hydnocarpus Wightiana* and of *Hydnocarpus Anthelmintica.* Isolation of a homologue of chaulmoogric acid." By F. B. Power and M. Barrowcliff.

"The constituents of the seeds of *Gynocardia Adorata.*" By F. B. Power and M. Barrowcliff.

"The relation of ammonium to the alkali metals. A study of ammonium, magnesium, and ammonium zinc sulphates and selenates." By A. E. H. Tutton.

"Camphorylazoimide." By M. O. Forster and H. E. Fierz.

"Diazo-derivatives of the mono-acylated aromatic para-diamines." By G. T. Morgan and F. M. G. Micklethwait.

"Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part III. Azo-derivatives of disubstituted aromatic meta-diamines." By G. T. Morgan and W. O. Wootton.

"The significance of optical properties as connoting structure: camphorquinone-hydrazones-oximes; a contribution to the chemistry of nitrogen." By H. E. Armstrong and W. Robertson.

"Solubility as a measure of the change undergone by isodynamic hydrazones. (1) Camphorquinonephenylhydrazone. (2) Acetaldehydephenylhydrazone." By W. Robertson.

"The design of gas-regulators for thermostats." By T. M. Lowry.

"The constitution of barbaloin. Part I." By H. A. D. Jowett and C. E. Potter.

"Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part IV. 5-Bromo-*as*(4)-dimethyl-2 : 4-diaminotoluene." By G. T. Morgan and A. Clayton.

"The action of hypobromous acid on piperazine." By F. D. Chattaway and W. H. Lewis.

"The action of magnesium methyl iodide on pinene nitrosochloride." By W. A. Tilden and J. A. Stokes.

"Racemisation phenomena during the hydrolysis of optically active menthyl and bornyl esters by alkali." By A. McKenzie and H. B. Thompson.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 9/6/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 297.

Thursday, June 1st, 1905, Professor R. MELDOLA, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Bryce Chudleigh Burt, B.Sc., Port of Spain, Trinidad, B.W.I.
Joseph Morgan Davey, Shetone House, Briton Ferry, Glam.
Herbert Drake Law, B.Sc., 152, Brixton Road, S.W.
Thomas Rigby, 23, The Square, Fairfield, Manchester.
Arthur Gough Ruston, B.A., B.Sc., 244, Oxford Road, Reading.

Of the following papers, those marked * were read:

***99. "The constituents of the seeds of *Hydnocarpus Wightiana* and of *Hydnocarpus anthelmintica.* Isolation of a homologue of chaulmoogric acid." By Frederick Belding Power and Marmaduke Barrowcliff.**

The fatty oils from the seeds of *Hydnocarpus Wightiana* (Blume) and *H. anthelmintica* (Pierre) have long been used in Western India and in China respectively for the same medicinal purposes for which chaulmoogra oil is employed. In view of this fact and of the interesting results obtained during the investigation of chaulmoogra seeds, from *Taraktogenos Kurzii*, King (Power and Gornall, *Trans.*, 1904, **85**, 838), the authors have examined the seeds of these two species of *Hydnocarpus* with especial regard to the constituents of their fatty oils.

The seeds of *H. Wightiana* yielded, on expression, 32·4 per cent., and by extraction with ether 41·2 per cent. of oil. The expressed oil had the following characters: m. p. 22—23°; sp. gr. 0·958 at 25°; $[\alpha]_D$ +57·7° in chloroform; acid value, 3·8; saponification value, 207; iodine value, 101·3.

The seeds of *H. anthelmintica* gave, on expression, 16·3 per cent., and by extraction with ether 17·6 per cent. of oil. The expressed oil had the following characters: m. p. 24—25°; sp. gr. 0·953 at 25°; $[\alpha]_D$ +52·5° in chloroform; acid value, 7·5; saponification value, 212; iodine value, 86·4.

The authors found that these two oils very closely resemble chaulmoogra oil (from *Taraktogenos Kurzii*) both in physical characters and in composition, consisting chiefly of the glyceryl esters of chaulmoogric acid, $C_{18}H_{32}O_2$, and a lower homologue of the same series, which was isolated from both oils and also from chaulmoogra oil. The new acid has the formula $C_{16}H_{28}O_2$, and is designated *hydnocarpic acid*; it crystallises from alcohol in glistening leaflets, melting at 60°, and having $[\alpha]_D$ +68° in chloroform. It is an unsaturated acid, containing only one ethylenic linking, and therefore possesses a closed carbon ring.

Methyl hydnocarpate, $C_{15}H_{27}\cdot CO_2Me$, is a colourless oil, which boils at 200—203° (corr.)/19 mm., and solidifies when cooled, forming crystals which melt at 8°. It has $[\alpha]_D$ +62·4° in chloroform. *Ethyl hydnocarpate*, $C_{15}H_{27}\cdot CO_2Et$, boils at 211° (corr.)/19 mm., is a colourless oil, and has $[\alpha]_D$ +51·6° in chloroform. *Hydnocarpamide*, $C_{15}H_{27}\cdot CO\cdot NH_2$, forms needles from alcohol. It melts at 112—113° and has $[\alpha]_D^{30^\circ}$ +70·2° in chloroform.

The oil of *Hydnocarpus Wightiana* appears to contain, besides the above-mentioned acids, a very small proportion of an acid or acids belonging to the linolic or linolenic series. The oil of *Hydnocarpus anthelmintica*, on the other hand, contains, as minor constituents, small amounts of oleic and palmitic acids.

*100. "The constituents of the seeds of *Gynocardia odorata*." By Frederick Belding Power and Marmaduke Barrowcliff.

Prior to the year 1900 it was generally believed that the chaulmoogra oil of commerce was obtained from the seeds of *Gynocardia odorata* (R.Br.). More recently, however, it has been recorded by Mr. E. M. Holmes (*Pharm. J.*, 1900, **64**, 522; 1901, **66**, 596), on the authority of Dr. Prain, Director of the Botanic Survey of India, that chaulmoogra oil is afforded by the seeds of *Taraktogenos Kurzii* (King), these seeds having evidently been wrongly referred to the genus *Gynocardia.* Moreover, one of the authors and Mr. F. H. Gornall (*Trans.*, 1904, **85**, 838) have shown that the oil from authentic *Taraktogenos* seeds is identical in physical character and composition with the chaulmoogra oil of commerce. The authors now state conclusively that the oil known in European commerce as "chaulmoogra oil," and sometimes as "gynocardia oil," could never have been obtained from the seeds of *Gynocardia odorata,* since the oil from these seeds, at the ordinary temperature, is a liquid, whereas chaulmoogra oil is solid (m. p. 22—23°). Furthermore, chaulmoogra oil is optically active and consists chiefly of the glyceryl esters of acids of the chaulmoogric series (compare Power and Gornall, *loc. cit.*, and the preceding abstract), whereas the oil from *Gynocardia* seeds is optically inactive and contains neither chaulmoogric acid nor its homologues.

The seeds of *Gynocardia odorata* used in this investigation were collected in Sylhet, Assam, and were of undoubted genuineness. They yielded, on expression, 19·5 per cent., and by extraction with ether 27·2 per cent. of oil, which had a light yellow colour and an odour like that of linseed oil. The expressed oil had the following characters: sp. gr., 0·925 at 25°; acid value, 4·9; saponification value, 197; iodine value, 152·8. It was found to consist of the glyceryl esters of the following acids: (1) linolic acid, or isomerides of the same series, constituting the largest proportion of the oil; (2) palmitic acid in considerable amount; (3) linolenic and *iso*linolenic acids, the latter preponderating; and (4) oleic acid in relatively small amount.

In addition to the fatty oil, *Gynocardia* seeds contain, as has previously been shown (Power and Lees, *Trans.*, 1905, **87**, 349), 5 per cent. of a crystalline cyanogenetic glucoside, gynocardin,

$$C_{13}H_{19}O_9N,1\tfrac{1}{2}H_2O,$$

and a hydrolytic enzyme, gynocardase.

*101. "The relation of ammonium to the alkali metals. A study of ammonium magnesium and ammonium zinc sulphates and selenates." By Alfred Edwin Howard Tutton.

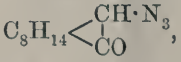
The results of this investigation are remarkably similar to those previously published (*Trans.*, 1903, **83**, 1049) for ammonium sulphate and its relations to the analogous sulphates of potassium, rubidium, and cæsium, and the following conclusions have been deduced.

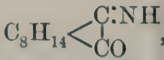
With regard to the three properties which refer to the fundamental structural unit of the crystals, namely, the molecular volume, the topic axes (the relative distances apart, along the three crystallographical axes, of the centres of contiguous structural units), and the molecular refraction, it is shown that the ammonium salt of any double salt group of the series behaves almost exactly like the rubidium salt. The same was previously shown to be true of ammonium sulphate in the simple salt series.

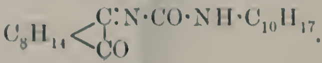
With respect to the properties of the crystals themselves, they resolve themselves into two classes. Those of the one category follow the order of the molecular weights, and include the densities, the rotation of the optical ellipsoid about the symmetry axis of the crystals, and the specific refraction and dispersion. In those of the other class, the ammonium salt occupies positions varying from one quite close to the rubidium salt to another nearer to the cæsium salt, and to this class belong the interfacial angles, the monoclinic axial angle, the three refractive indices (corresponding to the three axes of the optical ellipsoid), the mean refractive index for the whole crystal, the double refraction, and the axial ratios of the optical ellipsoid.

These definite results afford ample scope for speculation as to the spacial conditions which permit of the replacement of two atoms of the alkali metal potassium by ten atoms of the two ammonium groups, with no more effect on the crystallographical characters and on the dimensions and properties of the structural unit than if a mere exchange for two other analogous metallic atoms had occurred.

*102. "Camphorylazoimide." By Martin Onslow Forster and Hans Eduard Fierz.

Camphorylazoimide,  $C_8H_{14}<\begin{array}{l}CH\cdot N_3\\ \mid\\ CO\end{array}$, precipitated from a solution of camphoryl-ψ-semicarbazide nitrate by sodium nitrite, crystallises from alcohol in long, flattened, transparent prisms, which retain their lustre when protected from light, becoming opaque on exposure to sunlight during a few minutes; it melts at 67°, is volatile in steam, and decomposes on heating without explosion. Concentrated sulphuric acid, alcoholic alkali hydroxides, and an acid solution of stannous chloride liberate two-thirds of the nitrogen quantitatively, and reduction with zinc and acetic acid converts the substance into aminocamphor.

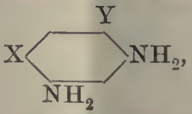
a-Iminocamphor,  $C_8H_{14}<\begin{array}{l}C{:}NH\\ \mid\\ CO\end{array}$, produced when alcoholic ammonia and alkalis act on the azoimide, is an unstable solid, which rapidly undergoes decomposition on exposure to air. Dilute acids resolve it quantitatively into ammonia and camphorquinone, whilst bornylcarbimide converts it into the stable *carbamide*,



$$C_8H_{14}<\begin{array}{l}C{:}N\cdot CO\cdot NH\cdot C_{10}H_{17}\\ \mid\\ CO\end{array}.$$

*103. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part III. Azo-derivatives of the symmetrically disubstituted primary meta-diamines." By Gilbert Thomas Morgan and William Ord Wootton.

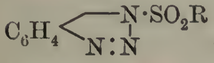
In 1902, one of the authors showed, from a study of three primary meta-diamines having the general formula



that these substances yield azo-derivatives, although much less readily and in smaller yield than those meta-diamines containing a free para-position with respect to one of the amino-groups. This investigation has now been extended to a larger series of these bases containing chlorine, bromine, iodine, and nitroxyl substituents, and the results obtained lead to the following conclusions: (1) the course of the condensation is not materially affected by an increase in the atomic weight of the halogen substituent, although the colour of the azo-compound deepens considerably; (2) the yield of the azo-derivative is greatly increased when a nitro-group is present in the nucleus of the diazonium salt, and to a less extent when this substituent is present in the molecule of the diamine.

The following new diamines have been prepared and characterised: 6-*chloro*-4-*nitro*-m-*phenylenediamine*, 6-*bromo*-4-*nitro*-m-*phenylenediamine*, and *di-iodo*-m-*phenylenediamine*.

*104. "Diazo-derivatives of monoacylated aromatic para-diamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

The authors having previously observed that benzenesulphonyl-*p*-phenylenediamine and camphor-*β*-sulphonyl-*p*-phenylenediamine when treated with nitrous acid yield diazo-anhydrides of the type  $C_6H_4\begin{cases}N\cdot SO_2R \\ N:N\end{cases}$, now show that this condensation occurs with other aromatic para-diamines, and *benzenesulphonyl*-2:5-*tolylenediazoimide*, *benzenesulphonyl*-2:5-p-*xylylenediazoimide*, and *benzenesulphonyl*-1:4-*naphthylenediazoimide* have been prepared.

A study of the diazo-derivatives of other monoacylated para-diamines indicates that the formation of similar cyclic diazoimides does not occur with the formyl, acetyl, succinyl, and benzoyl derivatives of *p*-phenylenediamine. From the first two members of this series, ill-defined nitrosoamines of the type $R\cdot CO\cdot NH\cdot C_6H_4\cdot NH\cdot NO$ have been produced, whilst benzoyl-*p*-phenylenediamine, when diazotised and treated with cold aqueous potassium carbonate, yields a remarkably stable diazonium carbonate, $C_6H_5{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}N_2{\cdot}HCO_3$. This substance, which is very sparingly soluble in water, dissolves with effervescence in cold dilute mineral acids, readily condenses to form azo-derivatives with phenols and aromatic amines, and when boiled with acidified water yields benzoyl-*p*-aminophenol (m. p. 205—207°).

Benzoyl-*p*-phenylenediamine also gives rise to a sparingly soluble yellow diazonium nitrite, $C_6H_5{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}N_2{\cdot}NO_2$, which readily yields azo-derivatives.

Discussion.

The President congratulated the authors on having, as far as he knew, been the first to isolate in a definite solid form a diazonium carbonate and nitrite. In many diazo-decompositions, and notably in the transformation of β-naphthylamine into β-nitronaphthalene, it was necessary to assume the intermediate formation of a diazonium nitrite, but such a salt had not hitherto been isolated.

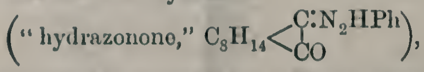
*105. "The significance of optical properties as connoting structure: camphorquinone—hydrazones—oximes; a contribution to the theory of the origin of colour and to the chemistry of nitrogen." By Henry E. Armstrong and William Robertson.

The authors discuss the significance of optical properties generally with reference to the structure of camphorquinone and the oximes and hydrazones derived therefrom; they apply the conclusions arrived at to the general problems of the connection between optical attributes and structure, ultimately expressing the view that there is not a tittle of proof in support of the Hantzsch-Werner hypothesis of isomerism among nitrogen compounds. Several new "hydrazones" are described.

Discussion.

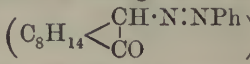
Dr. Lapworth said that Mr. Hann and he had not intended to offer any definite expression of opinion as to the correctness of Betti's formulæ for the isomeric hydrazones of camphorquinone, although they had certainly not avoided giving the impression that they approved of them.

In reality, his own opinion had been, firstly, that the substance melting at 180° was the true hydrazone



$$\left(\text{“hydrazonone,” } C_8H_{14}{<}\begin{matrix}C{:}N_2HPh\\ |\\ CO\end{matrix}\right),$$

and that the ferric chloride coloration it affords was due to an impurity not easily removed, and secondly that the products of change were one or both of the two stereoisomeric "azones"



$\left(C_8H_{14}<\begin{matrix}CH\cdot N:NPh\\ |\\ CO\end{matrix}\right)$.

However, as he and his colleague could not shake Betti's evidence nor adduce any direct evidence in favour of the other view, they did not find fault with this investigator's formulæ and adopted the terms first used by him.

*106. "Solubility as a measure of the change undergone by isodynamic hydrazones. (1) Camphorquinonephenylhydrazone, (2) acetaldehydephenylhydrazone." By William Robertson.

The applicability of the method of determining the variation in solubility with time as a means of estimating the proportions of isodynamic substances in solution has been further shown by extending the investigation to hydrazones. The relative proportion present in the equilibrate mixture in the case of the phenylhydrazone of camphorquinone is found to be about 9 : 1.

*107. "The design of gas-regulators for thermostats."
By Thomas Martin Lowry.

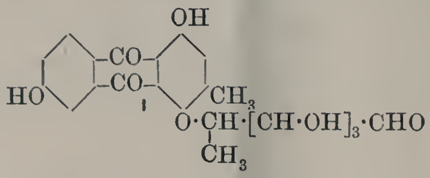
Tests are described of seven different regulators. Two new patterns are described. By means of one of these the temperature of a bath of water may be maintained within $\pm 0{\cdot}01°$ during several weeks, the average fluctuation being about $\pm 0{\cdot}002°$.

Discussion.

Sir W. Ramsay suggested the use of a Bourdon gauge tube and a small-sized regulator.

*108. "The constitution of barbaloin. Part I."
By Hooper Albert Dickinson Jowett and Charles Etty Potter.

The authors reviewed the previous work on this subject, and showed that there exist two very different views as to the empirical formula of barbaloin. The older formula, $C_{16}H_{18}O_7$, proposed by Tilden in 1875 (or the very slightly different one, $C_{16}H_{16}O_7$, of Groenewald) has been generally accepted until quite recently, when Léger, in 1902, adopted the formula $C_{21}H_{20}O_9$, and suggested that the constitution of barbaloin might be represented as follows:



The more recent work of Aschan has tended to confirm the older formula, $C_{16}H_{18}O_7$, rather than that of Léger.

The authors have made a number of analyses and molecular weight determinations of carefully purified barbaloin and tribromobarbaloin, and their results agree best with Tilden's formula. They have been unable to confirm Léger's statements respecting the decomposition of barbaloin with sodium peroxide, but have proved the correctness of Oesterle's results.

Tetra-acetyltribromobarbaloin, $C_{24}H_{23}O_{11}Br_3$, which was obtained in well-defined yellow needles, melts at 135°.

Tribromobarbaloin, and probably barbaloin, therefore, contain four hydroxyl groups. A number of experiments on the action of various reagents on barbaloin and tribromobarbaloin were recorded.

DISCUSSION.

Professor TILDEN remarked that much of the confusion existing in the work by earlier investigators of aloin arose from the fact that it was not fully recognised that the crystalline substances obtained from the several varieties of the drug were not identical. About 1870 this confusion began to be cleared away, and he believed that he was responsible for the application of the names barbaloin, socaloin, &c., to the several substances then recognised as distinct. The mistaken idea that the aloins are glucosides probably arose from the fact that most of them reduce Fehling's solution. He did not propose to resume the study of these substances, but wished success to Dr. Jowett and his colleague in their investigation.

*109. "Influence of substitution on the formation of diazoamines and aminoazo-compounds. Part IV. 5-Bromo-*as*(4)-dimethyl-2:4-diaminotoluene." By Gilbert Thomas Morgan and Arthur Clayton.

The base, 5-bromo-*as*(4)-dimethyl-2 : 4-diaminotoluene (m. p. 40°), has been prepared with the object of investigating the action of diazonium salts on a partially alkylated meta-diamine containing substituents in the two para-positions with respect to the aminic nitrogen. The orientation of the substituents in this diamine was determined by preparing the substance by the following alternative methods:

(1) Dimethyl-*p*-toluidine was converted into 2-nitrodimethyl-*p*-toluidine, and this compound, when successively reduced, acetylated, and brominated, yielded an *acetylbromo*-as(4)-*dimethyl*-2:4-*diaminotoluene* (m. p. 163°), from which the bromodiamine was isolated and further characterised by the preparation of its *benzoyl* and *benzenesulphonyl* derivatives.

(2) 3-Bromo-*p*-toluidine was successively nitrated and methylated, when a tertiary amine, $CH_3\cdot C_6H_2Br(NO_2)\cdot N(CH_3)_2$, was obtained, which on successive reduction and acylation gave rise to acyl derivatives identical with those produced by the foregoing method, and from which the same bromodiamine was produced on hydrolysis.

This base interacts with diazo-compounds only with difficulty; it gives an azo-dye on fabrics impregnated with diazotised primulin, but does not yield crystallisable azo-derivatives with the simpler diazonium salts.

*110. "The action of magnesium methyl iodide on pinene nitrosochloride." By William Augustus Tilden and Joseph Arthur Stokes.

The Grignard reagent attacks partly the chlorine of the nitrosochloride and partly the oxygen of the nitroso-group, substituting in each case an equivalent quantity of methyl. Two principal products are therefore obtained, namely, the oxime, $C_{10}H_{15}(CH_3)\colon NOH$ (m. p. 193°), and a base, $C_{10}H_{16}ClN(CH_3)_2$ (m. p. 122°). The oxime possesses well-marked basic properties and forms a crystallisable hydrochloride. The chlorine present in the base is not exchangeable for methyl by the further action of the reagent, but when treated with alcoholic potash it loses the elements of hydrogen chloride and produces an unsaturated base, $C_{10}H_{16}N(CH_3)_2$ (m. p. 112°), which is identical with dimethylpinylamine. Benzoyl and methyl ethers of the oxime are described in the paper as well as the hydrochlorides and other salts of the saturated chloro-base, of the unsaturated base derived from it, and of dimethylpinylamine prepared from pinylamine.

111. "The action of hypobromous acid on piperazine." By Frederick Daniel Chattaway and William Henry Lewis.

The *N*-dichloro-derivative of piperazine was described several years ago, but the corresponding bromine compound has not hitherto been prepared, owing probably to the circumstance that the action of hypobromous acid in excess on piperazine gives rise, not as usual to the substituted nitrogen bromide, but to an additive product of hypobromous acid and the base. The additive product, which is insoluble in water and chloroform, and rapidly decomposes on keeping, yields, however, diethylene dibromodiamine, $BrN(CH_2{\cdot}CH_2)_2NBr$, on treatment with an aqueous solution of the base. It crystallises from chloroform, in which it is easily soluble, in yellow, short, flattened prisms. On heating, it explodes with great violence at 79—80° without previously melting.

112. "Racemisation phenomena during the hydrolysis of optically active menthyl and bornyl esters by alkali." By Alexander McKenzie and Herbert Bryan Thompson.

A number of inactive acids were converted into their *l*-menthyl and *l*-bornyl esters respectively and the latter then submitted to fractional hydrolysis by being heated first with an amount of alkali insufficient for complete hydrolysis, whilst the mixture of esters, which survived the attack of the alkali in the initial hydrolysis, was then hydrolysed by an excess of alkali. In several cases, optically active acids of the same sign were obtained as products both of the initial and final hydrolysis. The results are indicated as follows:

	Direction of rotation of the acid from the initial hydrolysis.	Direction of rotation of the acid from the final hydrolysis.
l-Menthyl *dl*-phenylethoxyacetate...	–	–
l-Bornyl *dl*-phenylethoxyacetate ...	–	–
l-Bornyl *dl*-mandelate	–	inactive
l-Bornyl *dl*-lactate	inactive	–
l-Menthyl *dl*-lactate	+	–
l-Menthyl *dl*-α-ethoxypropionate ...	–	+
l-Bornyl *dl*-α-ethoxypropionate	+	–

No resolution was effected with *l*-menthyl *dl*-α-hydroxybutyrate, *l*-bornyl *dl*-α-hydroxybutyrate, and *l*-menthyl *dl*-β-hydroxybutyrate respectively.

The racemising effect of alkali during the hydrolysis of the esters examined is discussed.

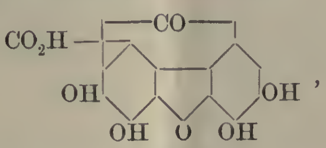
The fractional esterification of *i*-phenylethoxyacetic acid by *l*-borneol, the esterification of *l*-mandelic acid by *l*-borneol, the action of potassium hydroxide on *l*-malic acid, and the action of heat on the isomeric *l*-menthyl mandelates were investigated.

113. "Estimation of hydrogen peroxide in the presence of potassium persulphate." By John Albert Newton Friend.

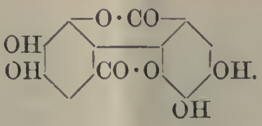
The author has already shown (*Trans.*, 1904, **85**, 597) that hydrogen peroxide cannot be correctly estimated in ordinary circumstances by titration with potassium permanganate in the presence of potassium persulphate. The amount of permanganate required always falls short of the theoretical. The author now shows that if a slight excess of permanganate is rapidly added from a burette to the mixture of peroxide and persulphate, and the excess of permanganate estimated iodometrically with thiosulphate, very accurate results may be obtained in the presence of any weight of potassium persulphate not exceeding 0·08 gram.

114. "Some oxidation products of the hydroxybenzoic acids and the constitution of ellagic acid." By Arthur George Perkin and Maximilian Nierenstein.

When gallic acid dissolved in sulphuric acid is treated with potassium persulphate with or without boric acid, *ellagic acid*, $C_{14}H_6O_8$, is formed (yield 67 per cent. approximately), a substance to which Goldschmidt and Barth (*Ber.*, 1879, **12**, 1237) and Goldschmidt and Jahoda (*Monatsh.*, 1892, **13**, 51) gave the constitution



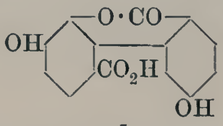
but which Graebe (*Ber.*, 1903, **36**, 212) considers is more probably



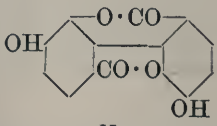
Tetra-acetylellagic acid, $C_{14}H_2O_8(C_2H_3O)_4$, sinters at about 305° and melts at 313—316°. Protocatechuic acid, in a similar manner, gives a compound, $C_{14}H_6O_6$, probably identical with Schiff's catellagic acid (*Ber.*, 1882, **15**, 2590), which he prepared by means of arsenic acid and for which he suggested either of the formulæ $C_{14}H_{10}O_7$ and $C_{14}H_8O_7$. This compound was obtained by the author as minute, colourless needles, melting above 360°, subliming at higher temperatures, and gave the *diacetyl* derivative, $C_{14}H_4O_6(C_2H_3O)_2$ (prismatic needles, m. p. 322—324°).

On distillation with zinc dust, it resembles ellagic acid in giving flourene.

From the product of the oxidation of *p*-hydroxybenzoic acid in the same manner, *catellagic acid*, $C_{14}H_8O_6$ (colourless, silky needles, m. p. above 360°), and a trace of protocatechuic acid have been isolated. The substance $C_{14}H_8O_6$ gives a *diacetyl* compound, $C_{14}H_6O_6(C_2H_3O)_2$ (long, colourless needles, m. p. 267—268°), and yields flourene on distillation with zinc dust, and by fusion with alkali two compounds, probably acids, which are still under examination. To this compound, $C_{14}H_8O_6$, which appears to result from the interaction of *p*-hydroxybenzoic acid and protocatechuic acid, the constitution (I)



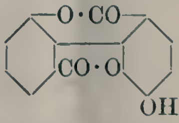
I.



II.

is assigned, from which that of catellagic acid follows (II). By analogy, ellagic acid can be similarly formulated, pointing strongly to the correctness of Graebe's suggestion (*loc. cit.*).

When oxidised by this method, *m*-hydroxybenzoic acid gives a complex mixture of yellow, crystalline substances and a yellow dyestuff not yet obtained crystalline, but there is also present a compound $C_{14}H_6O_5$ (colourless needles, m. p. 273—276°), subliming at higher temperatures, which is termed *metellagic acid.* The *monoacetyl* derivative, $C_{14}H_5O_5 \cdot C_2H_3O$ (colourless leaflets, m. p. 269—271°), has been prepared, and by distillation with zinc dust a hydrocarbon resembling *flourene* is produced. The constitution

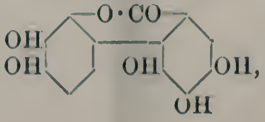


is assigned to this substance.

By the action of caustic potash on ellagic acid, Barth and Goldschmidt (*loc. cit.*) obtained hexahydroxydiphenylene ketone (?), $C_{13}H_8O_7$, and hexahydroxydiphenyl. It is now shown that the former compound gives the *penta-acetyl* derivative, $C_{13}H_3O_7(C_2H_3O)_5$ (small, colourless prisms, m. p. 217—219°), and the *pentabenzoyl* derivative,

$$C_{13}H_3O_7(C_7H_5O)_5$$

(colourless plates, m. p. 257—259°). Its constitution must accordingly be



as surmised by Graebe (*loc. cit.*), and this further confirms the above results.

On oxidation by this method, salicylic acid gives a product insoluble in water, and this result is being investigated together with the behaviour of other acids in this respect.

115. "The reduction of *iso*phthalic acid. Part II."

By William Lawton Goodwin and William Henry Perkin, jun.

The authors describe a convenient method for the preparation and separation of the *cis*- and *trans*-modifications of hexahydro*iso*phthalic acid, and show that the acid melting at 120—122° (Perkin, *Trans.*, 1891, **59**, 814; Baeyer and Villiger, *Annalen*, 1893, **276**, 255), which has so far been assumed to be pure *trans*-hexahydro*iso*phthalic acid, is, in reality, a mixture of about equal quantities of the *cis*- and *trans*-modifications. This mixture cannot be resolved by crystallisation, but treatment with calcium chloride and excess of ammonia on the water-bath causes the whole of the *cis*-acid to separate in the form of the sparingly soluble calcium salt, and the pure *trans*-acid is then obtained from the mother-liquors.

cis-Hexahydro*iso*phthalic acid melts at 162—163° and the *trans*-modification at 148°. These acids are partially converted into one another by heating with hydrochloric acid at 170°, and the *trans*-acid is completely converted into the anhydride of the *cis*-acid when it is heated with acetyl chloride at 150°. The action of bromine on these acids has been investigated, and the behaviour of mono- and di-bromo-*trans*-hexahydro*iso*phthalic acids, on treatment with alkalis, is discussed in detail.

116. "Complex ammonium antimonious halides."

By Robert Martin Caven.

Numerous double or complex alkali antimonious halides have previously been described (H. L. Wells and F. J. Metzger, *Chem. News*, 1901, **84**, 194). The existing types exhibit the following molecular ratios of alkali to antimonious halide, with or without water of crystallisation: 4 : 1, 3 : 1, 7 : 3, 2 : 1, 3 : 2, 1 : 1, 3 : 4, 4 : 7, 1 : 2, 1 : 3.

The following new salts have now been prepared:

$7NH_4Br,3SbBr_3$, pale yellow, hexagonal plates (found $NH_4 = 7{\cdot}18$; $Sb = 20{\cdot}39$; $Br = 72{\cdot}39$: calculated $NH_4 = 7{\cdot}13$; $Sb = 20{\cdot}42$; $Br = 72{\cdot}45$ per cent.).

$3NH_4Br,2SbBr_3$, bright yellow prisms (found $NH_4 = 5{\cdot}44$; $Sb = 23{\cdot}52$; $Br = 70{\cdot}94$: calculated $NH_4 = 5{\cdot}32$; $Sb = 23{\cdot}72$; $Br = 70{\cdot}97$ per cent.).

$3NH_4I,2SbI_3$, deep red, tetragonal plates (found $NH_4 = 3{\cdot}75$; $Sb = 16{\cdot}70$; $I = 79{\cdot}24$: calculated $NH_4 = 3{\cdot}76$; $Sb = 16{\cdot}74$; $I = 79{\cdot}49$ per cent.).

The double iodide had previously been obtained crystallising with $3H_2O$; the anhydrous compound is sensitive to light, the surface of a small quantity kept in a tube placed in a desiccator over sulphuric acid becoming light brown after some weeks.

The method of preparation of these salts consists in adding excess of glacial acetic acid (99—100 per cent.) to a concentrated aqueous solution of the two halides and the halogen acid, the complex salt quickly separating in a well crystallised condition. The same complex iodide always resulted, although the two constituent salts were mixed in varied proportions.

In the case of the bromides, the bright yellow salt was only obtained free from admixture with the pale salt when an amount of antimonious bromide in excess of that indicated by the formula was employed.

These salts, unlike ammonium platinichloride, are easily soluble in absolute alcohol, and, in the case at least of the bromides, the colours of their solutions in this solvent, as well as in the corresponding halogen acid, show that they do not break up considerably into their constituents when dissolved. Ammonium halide slowly separates from cold alcoholic solution, and evaporation gives rise to a mixture. An alcoholic solution of the pale bromide becomes darker when heated, but returns to its original colour on cooling; the bright yellow salt also forms a pale solution which darkens on heating. Thus it appears that two complex salts can exist in solution, a transition from one to the other taking place with change of temperature.

117. "The replacement of hydroxyl by bromine."

By William Henry Perkin, jun., and John Lionel Simonsen.

The preparation of compounds containing several atoms of bromine, by the action of hydrobromic acid on the corresponding alcohols, gives frequently very unsatisfactory results, not only because the reaction is usually incomplete, but also because considerable decomposition and formation of carbonaceous matter nearly always takes place. The authors find that much more satisfactory results are obtained when the acetate of the alcohol is heated at about 150°, with a solution of hydrogen bromide in acetic acid (saturated at 0°).

The following cases have been studied:

Triacetin yields *s*-tribromopropane, $CH_2Br{\cdot}CHBr{\cdot}CH_2Br$.

Erythritol tetracetate yields *s*-tetrabromobutane,

$CH_2Br{\cdot}CHBr{\cdot}CHBr{\cdot}CH_2Br$.

Penterythritol tetracetate, $C(CH_2{\cdot}O{\cdot}C_2H_3O)_4$, yields *s*-tetrabromotetramethylmethane, $C(CH_2Br)_4$, and tribromotrimethylcarbinyl acetate, $(CH_2Br)_3C{\cdot}CH_2{\cdot}O{\cdot}C_2H_3O$.

Mannitol hexacetate is converted into pentabromohexyl acetate, $C_6H_8Br_5(O{\cdot}C_2H_3O)$, and in this case it was not found possible to remove the remaining acetyl group even when the substance was heated at 170° for several hours with the acetic acid solution of hydrogen bromide.

118. "The ethereal salts and amide of dimethoxypropionic acid derived from *d*-glyceric acid." By Percy Faraday Frankland and Norman Leslie Gebhard.

The authors describe the preparation and properties of methyl, ethyl, propyl, butyl, heptyl, and octyl dimethoxypropionates, which they have obtained by the direct methylation by Purdie's method (*Trans.*, 1899, **75**, 153 and 483) (methyl iodide and silver oxide) of the corresponding ethereal salts of *d*-glyceric acid.

The *d*-glyceric esters are all lævorotatory, as are also the corresponding dimethoxypropionates, the latter having, however, a much higher molecular rotation, whilst the molecular rotations of the diacetylglycerates, di-propionylglycerates, di-monochloracetylglycerates, di-dichloracetylglycerates, di-trichloracetylglycerates, and di-phenacetylglycerates are intermediate between the two.

As in the case of the glycerates, the molecular rotation in the normal series attains a maximum in either the amyl, hexyl, or heptyl term (the normal amyl and hexyl terms being still unknown, the highest molecular rotation actually observed is that of the heptyl ester).

Tables are given comparing the molecular rotations of lactic and glyceric derivatives, on the one hand, and of malic and tartaric derivatives on the other.

The amide and methylamide of dimethoxypropionic acid have also been prepared. The amide has a higher molecular rotation (lævo) than glyceramide, whilst that of the methylamide is higher still.

The esters of dimethoxypropionic acid have their rotation diminished by rise of temperature, whilst the latter increases the rotation of the glycerates and diacetylglycerates.

119. "The influence of phosphates on the fermentation of glucose by yeast juice. Preliminary communication." By Arthur Harden and William John Young.

It has previously been shown by the authors (*J. Physiol.*, 1904, **32**; *Proceedings*, Nov. 12th) that the amount of glucose fermented by a given volume of yeast juice is greatly increased by the addition of boiled and filtered yeast juice.

When the rates of evolution of carbon dioxide are compared from (1) a mixture of yeast juice and glucose, and (2) a similar mixture to which boiled and filtered yeast juice has been added, it is found that two phenomena are concerned in the production of this increased fermentation in the presence of boiled yeast juice:

(*a*) The addition of the boiled juice produces an initial rapid evolution of carbon dioxide, which soon diminishes until a rate is attained which remains constant for many hours.

(*b*) This steady rate is usually, but not invariably, approximately equal to that given by an equal volume of the same yeast juice and sugar to which no addition has been made, but diminishes more slowly than this, so that the fermentation continues for a longer period.

The greater proportion of the total increase is usually due to this second phenomenon.

A similar initial rapid evolution of carbon dioxide occurs when a solution of sodium or potassium orthophosphate is added instead of the boiled juice, but in this case no marked prolongation of the fermentation is observed.

The extra quantity of carbon dioxide evolved in this initial period may be calculated by subtracting the amount corresponding with the constant rate from the total amount observed. It is then found that this quantity corresponds with the evolution of one molecular proportion of carbon dioxide for every atom of phosphorus added in the form of sodium or potassium orthophosphate, or present in the boiled juice in a form precipitable by magnesia mixture. The greatest amount of carbon dioxide hitherto obtained in this way from 25 c.c. of yeast juice is 0·46 gram, corresponding with the addition of about 1·5 grams of anhydrous disodium hydrogen phosphate.

Ordinary yeast juice itself contains a certain amount of dissolved phosphate, and hence, when sugar is added to it, the same phenomenon of an initial rapid evolution of carbon dioxide is observed, but it is usually small in amount.

This evolution of carbon dioxide is accompanied in all cases by the production of an equimolecular proportion of alcohol, and represents the alcoholic fermentation of a corresponding amount of glucose.

When the liquid in which fermentation has been carried on in presence of phosphate is boiled and filtered, the added phosphorus is found in the filtrate, but it is no longer in a form precipitable by magnesia mixture or silver nitrate. The exact mode of combination of this phosphorus in the filtrate and in the unboiled liquid has not yet been definitely ascertained.

Many other questions of interest arise in connection with this phenomenon and the whole subject is still under investigation.

120. "A contribution to the study of alkylated glucosides." By James Colquhoun Irvine and Adam Cameron.

By alkylating β-methylglucoside by means of silver oxide and methyl iodide, tetramethyl β-methylglucoside was produced, which was shown to be identical with the crystalline pentamethylated glucose previously obtained by the methylation of tetramethyl glucose. This confirms the idea that the alkylation of this sugar results in the formation of two isomeric alkylated glucosides which correspond respectively to α- and β-methylglucosides. The specific rotations of the completely methylated β-methylglucoside in water, alcohol, acetone, and benzene proved to be $-17{\cdot}34°$, $17{\cdot}43°$, $18{\cdot}07°$, and $16{\cdot}56°$ respectively.

The interconversion of α- and β-tetramethylmethylglucosides was carried out by heating either form with solutions of hydrogen chloride (0·25 per cent.) in methyl alcohol, acetone, ether, or benzene, the change being more rapid in alcohol than in the other solvents. In the absence of hydrogen chloride, no transformation took place.

Tetramethyl β-methylgalactoside was also prepared by alkylating β-methylgalactoside, and proved to be identical with the crystalline pentamethylated galactose already described (*Trans.*, 1904, 85, 1071), and thus the nature of the latter compound is established. In the course of this work a fully methylated galactoside was obtained which differed from the well-defined α- and β-isomerides in displaying a very low dextrorotation and in showing comparatively small changes in rotatory power when hydrolysed.

ADDITIONS TO THE LIBRARY.

III. *Pamphlets.*

Fresenius, H. Chemische Untersuchung der Römerquelle in Bad Ems. pp. 23. Wiesbaden 1905.

Long, J. H. Some complete urine analyses. (From the *J. Amer. Med. Assoc.*, 1905.)

—— On the specific rotation of salts of casein. (From the *J. Amer. Chem. Soc.*, 27, 1905.)

Warington, Robert. Lost fertility: the production and loss of nitrates in the soil. (From the *Trans. Highland and Agric. Soc. of Scotland*, 1905.)

Wetherell, E. W. A solution of the problem of the relationship of the elements, and a theory of the nature of matter deduced from the laws which govern the values of the atomic weights. pp. 40. Bangalore [1904].

LIST OF FELLOWS, 1905.

The List of Fellows for 1905 is now in active preparation, and no change of address received after July 31st, 1905, can be included in it.

At the next Meeting, on **Wednesday**, June **14th**, 1905, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"Influence of various sodium salts on the solubility of sparingly soluble acids." By J. C. Philip.

"The dielectric constants of phenols and their ethers dissolved in benzene and *m*-xylene." By J. C. Philip and Miss D. Haynes.

"Synthesis by means of the silent electric discharge." By J. N. Collie.

"The ultra-violet absorption spectra of benzene and certain of the mono-substituted derivatives." By E. C. C. Baly and J. N. Collie.

"Association in mixed solvents." By G. Barger.

"The ultra-violet absorption spectra of derivatives of benzene. Part II. The phenols." By E. C. C. Baly and Miss E. K. Ewbank.

"The action of water on diazo-salts. A preliminary note." By J. C. Cain and G. M. Norman.

"Synthesis of substances allied to epinephrine." By G. Barger and H. A. D. Jowett.

"A precise method of determining the organic nitrogen in potable waters." By J. Campbell Brown.

"Synthesis of 1 : 1-dimethyl-Δ^3-tetrahydrobenzene." By A. W. Crossley and Miss N. Renouf.

"Bromine in solutions of potassium bromide." By F. P. Worley.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics.*

The following Candidates have been proposed for election. A ballot will be held on Wednesday, June 14th, 1905.

Bealey, Edward Williams,

55, Belsize Park Gardens, Hampstead, London, N.W.

Gentleman. B.A. (Honours), Cambridge. Chemical Student, Finsbury Technical College. Interested in Chemical Discoveries and Investigations.

R. Meldola. F. Southerden.
John Castell-Evans. Harley F. Knight.
Chas. R. Darling.

Bees, William James,

43, Ash Grove, Hyde Park, Leeds.

Inspector of Schools to the Leeds Education Committee. B.Sc. (Lond.). Would be glad of the opportunity thus afforded to keep in touch with the most recent literature on the subject.

Arthur Smithells. S. Parrish.
W. Lowson. W. Ludford Freeman.
J. Hembrough.

Bennett, Joseph,

North Adams, Mass., U.S.A.

Print Works Manager. Silver Medallist of City and Guilds of London Institute. 1st Class Honors in Chemistry, South Kensington Examinations. Manager of the Windsor Printing Co., North Adams, Mass., U.S.A. Am desirous of getting the Publication of the Society for a knowledge of the latest work in chemistry.

Fred. S. Watson. Fred. R. Grundey.
S. Bradbury. Samuel Pollitt.
Fredk. Davis. *W. H. Perkin, jun.*

Bousfield, William Robert,
St. Swithin's, Hendon.

Barrister-at-Law, K.C. M.A. Cantab. Author of the following papers: "Influence of Temperature on the Conductivity of Electrolytic Solutions" (*Proc. Roy. Soc.*, 1902, **71**, pp. 42—54), "The Purification of Water by Continuous Fractional Distillation" (*Proc. Chem. Soc.*, 1903, **20**, 49), "The Electrical Conductivity and Other Properties of Sodium Hydroxide in Aqueous Solutions" (*Phil. Trans.*, 1905, **204**, 253—322), "Ionic Sizes in Relation to the Conductivity of Electrolytes" (*Proc. Roy. Soc.*, **74**, 563—564, 1905).

William A. Tilden.
Thomas Martin Lowry.
M. O. Forster.
R. Meldola.
W. H. Perkin, jun.

Campbell, Eric William,
97, Eaton Square.

Student at Central Technical College, South Kensington. Educated at Eton. Studied Chemistry for two years at Neuenheim College, Heidelberg. Now a student in the Department of Chemistry at Central Technical College, South Kensington.

Gerald T. Moody.
E. Frankland Armstrong.
E. Horton.
William A. Davis.
W. A. Lethbridge.
R. Berncastle.
M. O. Forster.

Cowie, William Beaverly,
26, East Claremont St., Edinburgh.

Teacher of Chemistry, Edinburgh Central School of Pharmacy. Student of Chemistry under Prof. W. H. Perkin, Ph.D., F.R.S., &c., 1889, 1890, 1891. Engaged in Analytical and Manufacturing Chemistry at the Laboratories of Messrs. T. and H. Smith & Co., Edinburgh, from 1892 to 1895. Teacher of Chemistry, Edinburgh Central School of Pharmacy, from 1895 to 1905.

W. H. Perkin, jun.
J. Gibson.
Leonard Dobbin.
George Senter.
H. Burrows.

Day, William Walpole,
Ellerslie, Harrogate.

Science Master. Bachelor of Science (Organic and Inorganic Chemistry and Mathematics), University of Wales. Science Master since 1898. Four years' work at Shaftesbury Grammar School and 2½ years' work at King Edward VI. School, Nuneaton, including in each case reorganisation of the Science side and building and fitting up of new laboratories.

J. J. Sudborough. J. P. Millington.
T. Campbell James. H. O. Jones.
W. J. Sell.

De Lury, Ralph Emerson,
Manilla, Ontario, Canada.

Fellow in Chemistry, University of Toronto. B.A., 1st Class Honours in Physics and Chemistry, University of Toronto, 1903; M.A., University of Toronto, 1904; has been instructor in the Department of Chemistry since graduation. Publications: "Rate of Oxidation of Potassium Iodide by Chromic Acid," *Journal of Physical Chemistry*, Vol. 7, No. 4, April, 1903.

W. R. Lang. W. H. Ellis.
W. Lash Miller. *William Ramsay.*
W. Lester Alton.

Donald, Robert,
75, Clyde St., Dunedin, N.Z.

B.A., M.A., B.Sc. (N.Z.); M.R.C.S. (Eng.); L.R.C.P. (Lond.); D.P.H. (Oxon.); holder of "A4" certificate as teacher under the Education Department of N.Z. Now practising Medicine. Studied Chemical Technology, and worked out a thesis on "The Composition and Calorific Power of some N.Z. Coals"; thus gained the M.A. degree with Honours (2nd class—Home examiners). Acted for two months in each of two successive years as Science Teacher in the Otago Training College, and for six months as (relieving) Science Master in Otago High School. As I am returning to New Zealand I wish to obtain the Journal of the Chemical Society, and to keep in touch with current Chemical Science.

Frederic Jas. M. Page. Hermann C. T. Gardner.
Hugh C. H. Candy. *John Wade.*
John Greenaway.

Forster, Ernest Lyle Carman,
Brampton, Ontario, Canada.

Assistant in Chemistry, University of Toronto. B.A., 1903, Chem. and Min. (Honours II. Class); M.A., 1904, Toronto: has been instructor in the Department of Chemistry since graduation; Publication:—"The Rate of Formation of Iodates in Alkaline Solutions of Iodine," *Dec.*, 1903, Journal of Physical Chemistry.

W. R. Lang. W. H. Ellis.
W. Lash Miller. *William Ramsay.*
W. Lester Alton.

Henstock, Herbert,

Feldeggstrasse 33, Zürich V, Switzerland.

Student of Chemistry. (1) Paper on Brom-dimethyl- and -trimethyl-succinic acids by W. A. Bone and H. Henstock (Trans. Chem. Soc., 1903, vol. 83). (2) I was three years as chemist to Messrs. Harrison, Blair & Co., Alkali Works, Farnworth, nr. Bolton, Lancs. (3) I took my degree, B.Sc. (Honours in Chemistry), Victoria University, 1902. (4) I have studied for 2 years at the University of Zürich under Prof. Werner, preparatory to taking the Ph.D. degree.

H. B. Dixon.
W. H. Perkin, jun.
Norman Smith.
G. H. Bailey.
D. L. Chapman.
William A. Bone.

Jarrard, William John,

41, Whittingstall Road, Fulham, S.W.

Demonstrator in Chemistry. B.Sc. (London, First Class Honours in Chemistry). A.R.C.Sc. (London). Teaching Associate, Royal College of Science (London). Student, Mason-University College, Birmingham (1896—1899), and Royal College of Science (London), 1899—1901 and 1902—1903. Science Master, the Grammar School, Amersham (1901—1902). Student-Demonstrator in Chemistry at Royal College of Science (1903—1905). Lecturer and Demonstrator in Chemistry at the Polytechnic, Kingston-on-Thames.

William A. Tilden.
M. O. Forster.
G. T. Morgan.
Chapman Jones.
G. S. Newth.

Mason, Arthur Walter,

6, Northumberland Place, North Shields.

Science Master. Bachelor of Science, London University (First Class in Final, Inter., and Matric.). Science Master, Tynemouth Secondary School and Pupil Teachers' Centre. Lecturer and Demonstrator in Chemistry in Evening Classes under Borough Council. Lecturer in Science to Teachers' Training Classes under Borough Council.

George Frederick Tyler Phillips.
S. Hewitt.
D. Tyrrell.
Thomas L. D. Porter.
Francis Sutton.

Ross, Frederick Wilson Montrose,

21, Soho Square, W.

Analyst to Messrs. Crosse and Blackwell, Ltd. Student at Finsbury Technical College, Evening Session, 1901—1902. 2½ years in the laboratory of Messrs. Burroughs, Wellcome & Co. Four years analyst to Messrs. Crosse and Blackwell.

R. Meldola.
Wyndham R. Dunstan.
John Castell-Evans.
F. Henry Streatfeild.
J. C. Crocker.
F. H. Lowe.

Steger, James,

111, Chesterfield Road, Bristol.

Science Teacher. B.Sc. (London) in Chemistry. Teacher of Chemistry for over ten years. Have worked as student in the laboratories of University College, Bristol, Yorkshire College, Leeds, and Royal College of Science.

Ernest H. Cook.
M. O. Forster.
G. T. Morgan.
Chapman Jones.
James C. Philip.
William A. Tilden.

Tuck, William Bradshaw,

University College, Gower Street, W.C.

Student. Inter. B.Sc. Have been 3 years in Sir William Ramsay's laboratory. At present engaged in Research Work.

William Ramsay.
J. Norman Collie.
Edward C. Cyril Baly.
J. K. H. Inglis.
Samuel Smiles.

White, John William,

9, Hampden Place, Halifax, Yorks, and University College, London.

Student. Intermediate, B.Sc. Two years in Sir William Ramsay's Laboratory, University College.

William Ramsay.
J. Norman Collie.
J. K. H. Inglis.
Edward C. Cyril Baly.
Samuel Smiles.

Wren, William James,

271, Park Road, Oldham.

Science Master, Waterford High Schools. Associate (Faculty of Applied Chemistry), ex-Royal Scholar and Exhibitioner, Royal College of Science, Dublin. Formerly private assistant to Professor W. N. Hartley and Demonstrator under the Department of Technical Instruction.

W. N. Hartley.
J. Holms Pollok.
F. G. Donnan.
W. E. Adeney.
J. Campbell Brown.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 30/6/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 298.

Wednesday, June 14th, 1905, Professor R. MELDOLA, F.R.S., President, in the Chair.

Mr. G. W. T. Horrod was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs. :

Harry Dunlop, Cragdarroch Cove, Dumbartonshire.
Eric Haydn-Morris, c/o Messrs. G. Mowling & Son, Footscray, Melbourne, Victoria.

The PRESIDENT announced that it had been decided by the Council that the ordinary meetings of the Society shall be held during the ensuing Session on the first and third Thursdays at 8.30 p.m.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

Edward Williams Bealey, B.A.
William James Bees, B.Sc.
Joseph Bennett.
William Robert Bousfield, M.A., K.C., M.P.
Eric William Campbell.
William Beaverly Cowie.
William Walpole Day, B.Sc.
Ralph Emerson De Lury, M.A.
Robert Donald, M.A., B.Sc., M.R.C.S., L.R.C.P.
Ernest Lyle Carman Forster, M.A.
Herbert Henstock, B.Sc.
William John Jarrard, B.Sc.
Arthur Walter Mason, B.Sc.
Frederick Wilson Montrose Ross.
James Steger, B.Sc.
William Bradshaw Tuck.
John William White.
William James Wren.

Of the following papers, those marked * were read :

*121. "Influence of various sodium salts on the solubility of sparingly soluble acids." By James Charles Philip.

That magnesium hydroxide is more soluble in ammonium chloride solutions than in pure water is due, according to one current explanation, to the formation of undissociated ammonium hydroxide and the consequent removal of hydroxyl ions, this leading to the solution of more hydroxide. If this is so, then conversely the solubility of sparingly soluble acids should be increased in the presence of sodium salts of weak acids. This is found to be actually the case, and the influence of sodium formate, acetate, and butyrate on the solubility of cinnamic, benzoic, salicylic, and *o*-nitrobenzoic acids has been determined at 26·4°. It is to be expected on theoretical grounds, and the expectation is confirmed by the experimental results, that the extent to which the solubility of a given sparingly soluble acid is increased by the presence of the sodium salt NaA will depend on the strength of the acid HA. If the concentration of the sparingly soluble acid in the saturated solution is plotted against the concentration of the added salt (NaA, NaA′, NaA″, &c), it is found that the order of the curves so obtained is the order of strength of the acids HA, HA′, HA″, &c. Further, the increase of solubility of cinnamic acid (for example) in a solution of NaA of known concentration, as compared with its solubility in pure water, can be calculated in good agreement with experiment when the solubility product for cinnamic acid and the dissociation constant of the acid HA are known.

*122. "The dielectric constants of phenols and their ethers dissolved in benzene and *m*-xylene." By James Charles Philip and Dorothy Haynes.

Evidence was brought forward some time ago by one of the authors (Philip, *Zeit. physikal. Chem.*, 1897, 24, 18) showing that the dielectric constant of an alcohol calculated from the dielectric constant of its benzene solution decreases as the concentration of the alcohol decreases, and is in all cases less than the directly determined dielectric constant of the pure alcohol. This behaviour, connected probably with the associative tendency of the alcohol molecules, has now been observed also in the case of phenols. The phenomenon is well marked in the case of phenol itself, but less distinct in the case of the cresols; indeed, the dielectric power of *o*-cresol in benzene solution seems to be nearly independent of the concentration. The phenol ethers, in which the associative tendency has been got rid of by obliterating the hydroxy-group, exhibit an almost normal dielectric behaviour in benzene solution. It is noteworthy that the introduction of a methyl group at any point in the ring lowers the dielectric constant of anisole, the lowering effect, however, of the methyl group being much greater in the ortho-position than in either the meta- or para-position.

DISCUSSION.

Sir WILLIAM RAMSAY inquired whether Dr. Philip's measurements threw any light on the fact that the molecular weight of alcohol in benzene solutions may rise as high as 230. Was this due to polymerisation of the alcohol or to a compound of alcohol with benzene?

Dr. PHILIP said that although the dielectric property of alcohol in benzene had been found to diminish with dilution in an analogous manner to the molecular weight, no evidence had been obtained bearing on the point referred to by Sir William Ramsay.

*123. "Synthesis by means of the silent electric discharge."

By John Norman Collie.

When pure ethylene was submitted to the action of the silent electric discharge in a vessel cooled to −20°, polymerisation occurred, and a liquid was produced together with some hydrogen gas. In one experiment, 210 c.c. of ethylene gave about 40 c.c. of hydrogen.

Ten grams of the liquid produced by the polymerisation of ethylene were fractionated. The fractions collected and their analyses were as follows:

	100°.	100—150°.	150—200°.	200—250°.	Residue.	Distilled residue.
C	83·4	85·3	85·8	86·0	87·7	87·7
H... ..	16·0	15·3	14·3	14·0	12·4	12·3

The first fraction was very small; most of the distillate collected in the two fractions 100—150° and 150—200°, the chief part boiling between 130° and 170°. The residue left in the flask was a dark resinous substance, which, on heating, smelt of burnt india-rubber; this product weighed 4 grams, or two-fifths of the whole.

The decrease in hydrogen and increase in carbon in the above analyses is interesting; olefinic hydrocarbons, C_4H_{24} require $C=85·7$; $H=14·3$; $C_{20}H_{34}$ requires $C=87·7$; $H=12·3$ per cent.

These various fractions were oxidised by means of potassium permanganate solution in the cold. After filtering off the precipitated manganese oxide, the solution of potassium salts was acidified; a strong odour of either valeric or caproic aldehyde was at once produced in the case of the two fractions (100—150°) and (150—200°). These aldehydes were distilled in steam and oxidised with silver oxide. The silver salt gave, on analysis, Ag = 48 per cent., which is equivalent to an acid of molecular weight 118, that of caproic acid being 116.

Ethylene was also mixed with carbon monoxide and submitted to the silent electric discharge, when aldehydes were formed in small quantity. Formaldehyde and acrolein were both probably present, but the chief condensation that occurred was that of the ethylene itself to form hydrocarbons having high boiling points.

The facts that are of especial interest are that ethylene under the influence of the silent electric discharge at the ordinary temperature will not only unite with carbon monoxide, but will also polymerise, yielding a series of complicated hydrocarbons; the chief substances formed boil at about 150—160° and apparently approximate in composition to $C_{10}H_{20}$; moreover, further condensation means loss of hydrogen and the formation of compounds approximating both in properties and composition to the terpene derivatives. On oxidation, the olefinic hydrocarbons break down, yielding compounds containing about six carbon atoms in the molecule.

DISCUSSION.

Mr. HARCOURT referred to experiments on ozone by Sir B. Brodie, in which the oxygen exposed in a Siemens tube to the silent discharge was mixed with a large proportion of carbon dioxide, the idea being that ozone might be protected during its formation by dilution with carbon dioxide and obtained afterwards in a concentrated form by absorption of the diluent. The results, however, showed that carbon dioxide was decomposed and ozone formed from it; moreover, a brown coating was deposited on the glass, this product being readily soluble in water. This experiment seemed to be an illustration of Dr. Collie's view that the syntheses which plants effect under the influence of sunlight, forming complex products out of carbon dioxide and water, may be to some extent paralleled by the action of the silent discharge.

Professor TILDEN reminded the author that experiments of the same character and having similar results had already been carried out by Berthelot (Journ. Chem. Soc., 1876, ii, 596).

The PRESIDENT considered that not the least interesting part of Professor Collie's paper was the fact that he had succeeded in obtaining a sufficient quantity of the synthesised products to enable him to give definite and quantitative information as to their nature. Most of the workers who had studied the synthetical action of the silent electric discharge had hitherto only given qualitative results. With reference to the polymerising action of this discharge, he (the President) mentioned that some years ago, in conjunction with Mr. R. J. Strutt, he had made some experiments having for their object the possible combination of argon with acetylene. No combination was observed, but the polymerising action of the discharge on the acetylene was very obvious, an accumulation of tarry and resinous products being obtained, but these were not further examined, as practically the whole of the argon originally mixed with the acetylene was recovered at the end of the experiments. With respect to photosynthetic processes, he thought it might be of interest, in view of the modern developments of radioactivity, to call attention once again to the older work of Fay and of Seekamp, who state that photochemical decompositions are in many cases promoted by the addition of uranium salts to the solutions. This raises the question whether the energy, which must be supposed to be liberated on the "disintegration" hypothesis of the uranium atom, may not play a part in such photochemical processes.

*124. "The ultra-violet absorption spectra of aromatic compounds. Part I. Benzene and certain mono-substituted derivatives." By Edward Charles Cyril Baly and John Norman Collie.

The ultra-violet absorption spectra of benzene and of some of its mono-substituted derivatives were described. It has been found that benzene presents seven separate absorption bands, and it was shown how the formation of these may be accounted for by attributing each one to a separate and distinct process of dynamic isomerism connected with the linking changes within the benzene molecule. In the case of the mono-substituted derivatives of benzene, it is shown how their absorption spectra may be arranged in types, and it appears that each type corresponds either to complete saturation or to the nature and position of unsaturated atoms in the substituent group. The presence of an unsaturated atom in the α-, β-, or γ-position in the side-chain thus produces a particular type of absorption. When the unsaturated atom is present in the δ-position, it is apparently removed too far from the nucleus to exercise any effect, with the result that the same absorption spectrum is obtained as if the side-chain were completely saturated.

*125. "The ultra-violet absorption spectra of aromatic compounds. Part II. The phenols." By Edward Charles Cyril Baly and Elinor Katharine Ewbank.

The ultra-violet absorption spectra of anisole and phenetole are found to differ from that of phenol; in the former cases, the single absorption band given by phenol is subdivided near its head into two bands.

The absorption band produced by the dynamic isomerism existing in solutions of acetylacetone and similar tautomeric substances of the aliphatic series occupies very nearly the same position as the band given by phenol. The existence of a similar type of dynamic isomerism in the case of phenol would, therefore, explain the difference between the spectra of phenol and its ethers. The presence of this kind of tautomerism, that is, a labile hydrogen atom, in phenol is proved by the influence of acid and alkali on the spectrum of this substance. Just as in the case of certain aliphatic tautomeric compounds, the position of the absorption band is shifted towards the red on the addition of sodium hydroxide, whilst the addition of acid tends to restrain the dynamic isomerism. The results obtained with the three dihydroxybenzenes, the three cresols, and *p*-aminophenol support the view that similar tautomerism exists in these substances.

*126. "Association in mixed solvents." By George Barger.

The association which many hydroxylated substances exhibit in some solvents (benzene, chloroform) does not occur in others (alcohol, acetic acid), probably because the latter form loose molecular compounds with the solute according to the law of mass action (Abegg, *Zeit. anorg. Chem.*, 1904, **39**, 330). In dilute solutions, the concentration of the solvent is large compared with that of the solute, and if the solvent is dissociative its influence predominates. The present investigation deals with cases in which the concentration of the dissociative solvent was reduced by mixing it with an associative one.

The dissolved substances were acids, alcohols, phenols, and oximes. Dilute solutions of these were made in mixtures of toluene, benzene, chloroform, or carbon tetrachloride with one of the following dissociative solvents: pyridine, acetic acid, ethyl acetate, methyl acetate, ethyl formate, ethyl alcohol, methyl alcohol, and acetone. The molecular weight of the solute was determined by the author's microscopic method (*Trans.*, 1904, **86**, 286), this process being particularly suited for work with mixtures.

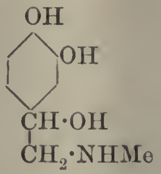
The results are in general agreement with what might be expected from mass action according to the above theory. The molecular weight is normal in nearly all the mixtures, and association only persists when the percentage of the dissociative solvent is very small.

The esters are the least powerful of the dissociative solvents examined, which is in accordance with their behaviour in other respects. For instance, as the result of a study of the boiling points of homologous series, Young places the esters between associated and non-associated liquids (*Phil. Mag.*, 1905, [vi], **9**, 1).

According to Lachman (*J. Amer. Chem. Soc.*, 1903, **25**, 50), brown solutions of iodine owe their colour to the formation of loose molecular compounds between solute and solvent. If equal volumes of an alcoholic and a chloroform solution containing equal quantities of iodine are mixed, the colour of the mixture is not intermediate between that of the component solutions, but is more like that of the alcoholic solution. This experiment serves to illustrate the mass action effect of the solvent.

*127. "Synthesis of substances allied to epinephrine." By George Barger and Hooper Albert Dickinson Jowett.

The authors have attempted to synthesise a compound having the formula



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which was proposed by one of them (Trans., 1904, **85**, 192) for epinephrine (adrenaline), the active principle of the suprarenal gland.

Although the methylene and dimethyl ethers were prepared, the dihydroxy-base could not be isolated.

The constitution of the ether bases was proved by their oxidation to piperonylic or veratric acid respectively. The dihydroxy-base could not be obtained from the ethers, although indications of the formation of a substance having the chemical and physiological properties of epinephrine were obtained by the action of dilute hydrochloric acid at 150° on the methylene ether.

The following compounds were prepared and described: α-3 : 4-*methylenedioxyphenyl-αβ-dibromoethane*, $CH_2{:}O_2{:}C_6H_3\cdot CHBr\cdot CH_2Br$, needles, m. p. 82—83°; α-3 : 4-*methylenedioxyphenyl-β-bromo-α-hydroxyethane*, $CH_2{:}O_2{:}C_6H_3\cdot CH(OH)\cdot CH_2Br$, long needles, m. p. 107—108°; β-3 : 4-*methylenedioxyphenyl-β-hydroxyethylmethylamine picrate*,

$$CH_2{:}O_2{:}C_6H_3\cdot CH(OH)\cdot CH_2\cdot NHMe,C_6H_3O_7N_3,$$

yellow needles, m. p. 178°; the corresponding *base* and *platinichloride* are amorphous: 3 : 4-*dimethoxystyrene*, $(CH_3O)_2{:}C_6H_3\cdot CH{:}CH_2$, colourless liquid boiling at 120—125°/10 mm.; α-3 : 4-*dimethoxyphenyl-αβ-dibromoethane*, $(CH_3O)_2{:}C_6H_3\cdot CHBr\cdot CH_2Br$, needles, m. p. 102°; α-3 : 4-*dimethoxyphenyl-β-bromo-α-hydroxyethane*,

$$(CH_3O)_2{:}C_6H_3\cdot CH(OH)\cdot CH_2Br,$$

long needles, m. p. 68°.

The corresponding methylamine *base* could not be crystallised, nor could any crystalline salt be obtained.

The piperonyldibromide (m. p. 160°) described by Mameli (*Gazzetta*, 1904, **34**, [i], 358) is really the *dibromohydrin*,

$$CH_2{:}O_2{:}C_6H_2Br{\cdot}CH(OH){\cdot}CH_2Br,$$

and has been obtained by the action of bromine water on the bromohydrin and also by the action of phosphorus pentachloride on the dibromide.

*128 "The determination of melting points at low temperatures." By Leo Frank Guttmann.

A method has been worked out for readily determining melting points at low temperatures by means of a constantan-copper couple connected to a delicate galvanometer. The couple was calibrated by immersion in substances of known melting point; ice, chloroform, ether, liquid air, and a mixture of solid carbon dioxide and alcohol being chosen. The melting point of ethyl bromide had been determined by a previous observer to be $-129{\cdot}5°$, and it is now shown to be $-118°$, the low number formerly obtained being due to an admixture of ether. The melting point of some very pure toluene was also found to be higher than that of ordinary pure toluene, to which the melting point $-97°$ to $-99°$ had been ascribed.

The melting points determined were methyl alcohol, $-98°$; ethyl alcohol, $-117{\cdot}3°$; methyl iodide, $-64°$; ethyl chloride, $-142°$; ethyl bromide, $-118°$; ethyl iodide, $-109°$; toluene, $-92°$; *m*-xylene, $-55°$; ethylbenzene, $-93°$.

Ethyl alcohol was found to have the property of supercooling to a remarkable degree. It could be frozen to a clear, transparent glass by immersion in liquid air, and if it was then allowed to warm up slowly to $-135°$, crystallisation set in explosively, the temperature rising about 20° in 10 seconds and a white, opaque mass of crystallised alcohol being formed.

29. "The action of water on diazo-salts. A preliminary note." By John Cannell Cain and George Marshall Norman.

One of the authors has shown (*Trans.*, 1903, **83**, 688) that little or no hydroxy-compound is obtained by boiling certain ortho-substituted diazo-salts of the diphenyl series with dilute acids, but that quinonoid derivatives resulted. As there are a large number of similarly substituted compounds belonging to the benzene series which are said not to yield the corresponding phenols on boiling with water or acids, it appeared to be of interest to examine these with the object, if possible, of elucidating the course of the reaction.

s-*Tribromoaniline.*—Silberstein (*J. pr. Chem.*, 1883, **27**, 98) was unable to obtain any phenolic derivative by boiling *s*-tribromobenzenediazonium sulphate or nitrate with dilute acids, and Orton, in a recent communication (Proc., 1905, **21**, 168), obtained no trace of the phenol either with dilute or strong sulphuric acid. By using the method described in the German Patent 95339, which consists in heating the diazo-solution with a mixture of dilute sulphuric acid and sodium sulphate (applied in the patent to the production of guaiacol from *o*-anisidine), we have been able to isolate the corresponding s-*tribromophenol* (m. p. 92—93°), although the yield is small.

The failure of other observers to obtain this product is no doubt explained by the facts that the decomposition point of this very stable diazo-salt is considerably above 100°, and by using more concentrated sulphuric acid in order to reach a higher temperature a very considerable retarding influence is introduced.

This retarding influence can be measured by determining the "coefficient of decomposition, C," according to the method described by one of the authors (*Trans.*, 1902, **81**, 1412). Thus in the case of diazobenzene chloride, the value of C in the case of the chloride is 0·0298 (*loc. cit.*, p. 1420).

A blank experiment in which an equivalent quantity of sulphuric acid was substituted gave exactly the same number, the diazo-solution containing 0·7 per cent. of H_2SO_4. When, however, the amount of sulphuric acid is increased until the solution contains about 35 per cent. of the acid, the value of C becomes 0·0191. It follows, therefore, that an increase in the quantity of sulphuric acid produces an increase in the stability of the diazo-compound (compare *Ber.*, 1890, **23**, 2994).

s-*Trichloroaniline.*—Hantzsch (*Ber.*, 1895, **28**, 685) prepared a solution of the diazo-chloride of this substance, and was unable to detect the formation of the corresponding phenol by the action of heat. He says, "Trichlordiazobenzolchlorid lässt sich mit Wasser, ja selbst mit Salpetersalzsäure kochen, ohne Stickstoff zu entwickeln oder sich überhaupt zu verändern."

The authors have found that under the usual conditions of boiling a brown substance is formed, but only by adopting the same method as in the foregoing instances can a small yield of s-*trichlorophenol* (m. p. 68°) be obtained.

o-*Anisidine.*—Several workers have been unsuccessful in obtaining guaiacol from the diazo-compound of *o*-anisidine. Thus Limpach

(*Ber.*, 1891, **24**, 4136) passed a current of steam through the solution, but could detect no guaiacol (compare also Gattermann, *Ber.*, 1899, **32**, 1136).

By passing steam through a strongly acidified solution of the diazo-sulphate for several hours, the authors obtained guaiacol, a still better yield being afforded by the foregoing method. In addition to this product, a small yield of a second substance was isolated; this product crystallised in flat, square tables (m. p. 89°; b. p. 310—312°), giving analytical numbers corresponding with those for the monomethyl ether of *o*-dihydroxydiphenyl, $OH\cdot C_6H_4\cdot C_6H_4\cdot OCH_3$.

3-Bromo-p-*toluidine.*—Wroblewski (*Ber.*, 1874, **7**, 1061; *Annalen*, 1873, **168**, 147) describes several halogen derivatives of aniline and toluidine, the diazo-compounds of which do not yield halogenated phenols, but give rise to the corresponding substituted hydrocarbons. In a later paper (*Ber.*, 1884, **17**, 2704), he attributes this abnormality to the presence of a small quantity of alcohol in the diazo-derivative. As regards the above compound, this is probably a correct explanation, as a good yield of the bromo-cresol (b. p. 214°; *Ber.*, 1884, **17**, 2530) is readily obtained by passing steam through an acid solution of the sulphate.

3-Chloro-p-*toluidine*, the diazo-compound of which is said by Wroblewski (*loc. cit.*) to yield no corresponding phenol when treated in a similar way, gave rise to 3-*chloro*-p-*cresol* (m. p. 191°).

130. "A precise method of estimating the organic nitrogen in potable waters." By James Campbell Brown.

Details were given of a process for the estimation of the whole of the nitrogen of organic matter in potable water and sewage effluents.

The process is found to be as accurate for this purpose as Kjeldahl's method is for larger quantities of nitrogenous matter, and it has many advantages over Kjeldahl's process in convenience and speed, and in the absence of the liability to breakage and loss by bumping in glass vessels.

The process essentially consists in the distillation to dryness and subsequent ignition of a mixture of a portion, ordinarily 200 c.c., of the sample, without previous evaporation, with potassium hydroxide and potassium permanganate. The operation is carried on either in a Jena glass or in a copper retort, and the ammonia evolved is estimated by Nessler's solution.

The total carbon of the organic matter was also estimated as carbon dioxide in the residue remaining in the retort, but the results were not so accurate as in the case of the nitrogen, owing to the large amount of carbon dioxide found by blank experiments, which has to be deducted.

The results obtained by this process on a variety of waters are compared with the corresponding values determined by the Frankland, Wanklyn, and Forchammer methods.

131. "Synthesis of 1 : 1-dimethyl-Δ^3-tetrahydrobenzene."

By Arthur William Crossley and Nora Renouf.

When 3-bromo-1 : 1-dimethylhexahydrobenzene (compare Proc., 1905, **20**, 242) is heated with alcoholic potash, it loses the elements of hydrogen bromide with formation of 1 : 1-*dimethyl*-Δ^3-*tetrahydrobenzene*, which is a colourless, refractive liquid boiling at 117—117·5°/770 mm., and having an odour of turpentine. It combines with bromine to form 3 : 4-*dibromo*-1 : 1-*dimethylhexahydrobenzene*, and on oxidation with potassium permanganate yields $\beta\beta$-dimethyladipic acid, a fact which definitely proves its constitution.

A mixture of concentrated nitric and sulphuric acids acts on the hydrocarbon very violently and does not give rise to an appreciable quantity of a nitro-derivative.

The properties of the hydrocarbon are being compared with those of laurolene and *iso*laurolene obtained from derivatives of camphoric acid.

132. "Bromine in solutions of potassium bromide."

By Frederick P. Worley.

The solubility of bromine in aqueous solutions of potassium bromide has been determined over a wide range of concentrations at 18·5° and 26·5°. The curves obtained for concentrations below 0·1 gram-molecule per litre correspond with an additional absorption of two atoms of bromine for every molecule of potassium bromide in solution, probably due to the formation of KBr_3. The curves for higher concentrations of potassium bromide deviate slightly on the side of increased solubility of bromine, probably indicating the formation of small quantities of compounds higher than KBr_3.

The application of the principle of mass action does not lead to any knowledge of the constitution of the polybromide formed in the case of solutions saturated with bromine, but with solutions containing varying amounts of bromine insufficient for saturation the results confirm the formation of KBr_3 with smaller quantities of a higher compound.

The variation of the constants obtained, on the assumption that

KBr_3 alone is formed, may be due to the unequal ionisation of potassium bromide and KBr_3.

A simple process has been devised for the determination of the quantity of a volatile substance present in a system containing various substances in equilibrium, where estimation by chemical means is not possible. It possesses the great advantage over other similar methods of avoiding the presence of a foreign substance such as carbon disulphide.

133. "Tetramethylammonium hydroxide." By James Walker and John Johnston.

A solution of tetramethylammonium hydroxide may easily be prepared by mixing alcoholic solutions of tetramethylammonium chloride and potassium hydroxide. Potassium chloride at once separates and may be removed by filtration. Tetramethylammonium hydroxide may be isolated from this solution as the pentahydrate, $NMe_4{\cdot}OH,5H_2O$, by addition of water and concentration in a vacuum. A trihydrate and a monohydrate are also described. Attempts to prepare the anhydrous hydroxide failed owing to decomposition of the monohydrate into trimethylamine, methyl alcohol, and water.

134. "Tetrethylsuccinic acid." By James Walker and Annie Purcell Walker.

Crum Brown and Walker isolated from the product of electrolysis of sodium ethyl diethylmalonate a crystalline substance having the composition $C_{12}H_{20}O_3$. This substance is now shown to be the anhydride of tetrethylsuccinic acid. It is attacked by alkalis only with great difficulty, but forms sodium methyl tetrethylsuccinate by direct addition with sodium methoxide. This ester salt may be saponified by boiling with aqueous alkalis, and from the salt obtained tetrethylsuccinic acid may be isolated. It is stable in the solid state, but passes in solution or on fusion into water and the anhydride.

135. "The ultra-violet absorption spectra of aromatic compounds. Part III. Disubstituted derivatives of benzene." By Edward Charles Cyril Baly and Elinor Katharine Ewbank.

Hartley (*Trans.*, 1885, 47, 685), in describing the ultra-violet absorption spectra of the three xylenes, showed that the broad absorption band given by the ortho- and meta-compounds was divided into two in the case of the para-compound. *p*-Xylene therefore gives two absorption bands, while the ortho- and meta-compounds only show one band. In the present paper, the following substances are dealt with, the absorption spectra of the three isomerides being described in each case: the chlorotoluenes, the dichlorobenzenes, the tolunitriles, the chloroanilines, and the toluidines, the last two compounds being examined in acid solution. In every case, the para-compound shows either more absorption bands than the ortho- and meta-isomerides, or the same number of bands with much greater persistence. It may therefore be concluded that the para-compound is always more symmetrical than its two isomerides, that is to say, the motions of the benzene ring, which give rise to the absorption bands, are less disturbed by the para-substitution than by the ortho- and meta-substitutions.

136. "Studies in chlorination. II. The action of chlorine on boiling toluene. Preliminary notice." By Julius Berend Cohen, Harry Medforth Dawson, and Percy Field Crosland.

The object of the authors' experiments was to ascertain if electrolytic chlorine, evolved in presence of boiling toluene, entered the side-chain like ordinary chlorine or caused substitution in the nucleus. The results show that, under the conditions of the experiments, electrolytic chlorine enters the nucleus only, and also that the rate of chlorination appears to be more rapid than that of ordinary chlorine evolved from pyrolusite and hydrochloric acid. The current was conducted through the mixture of toluene and hydrochloric acid by means of carbon electrodes, a special series of determinations being made to find whether the electrodes acted as carriers. No difference could be detected in the character of the products when ordinary chlorine was used, whether carbon electrodes were present or not. When ordinary chlorine was used, between 80 and 90 per cent. of the product was benzyl chloride, the remainder being a mixture of *o*- and *p*-chlorotoluenes. The experiments are being continued.

137. "Purpurogallin." By Arthur George Perkin.

When purpurogallin is methylated by means of methyl sulphate, it yields, in addition to the trimethyl ether previously described (*Trans.*, 1903, **83**, 194), the *tetramethyl* compound, $C_{11}H_4O(OCH_3)_4$ (found, $C = 65{\cdot}18$; $H = 5{\cdot}90$; $CH_3 = 21{\cdot}57$, pale yellow prisms, m. p. 93—94°). *iso*Purpurogallone, for which the formula $C_{11}H_6O_5$ was suggested, is more probably $C_{11}H_8O_5$ (found, $C = 60{\cdot}08$; $H = 3{\cdot}54$); it gives on digestion with sulphuric acid in the presence of acetic acid the *anhydride*, $C_{11}H_6O_4$ ($C = 65{\cdot}36$; $H = 2{\cdot}80$, minute, yellow prisms melting above 310°), the acetyl compound of which is identical with that prepared by the action of acetic anhydride on *iso*purpurogallone (*loc. cit.*). iso*Purogallone tetramethyl ether*, $C_{11}H_4O(O{\cdot}CH_3)_4$ (found, $C = 65{\cdot}57$; $H = 5{\cdot}62$, colourless needles, m. p. 211—213°), is prepared by the action of methyl sulphate. The acid obtained from purpurogallin trimethyl ether by means of alcoholic potash at 180° (*loc. cit.*) gives numbers ($C = 62{\cdot}87$; $H = 5{\cdot}07$) corresponding with the formula $C_{13}H_{12}O_5$, and is probably a derivative of *iso*purpurogallone. From purpurogallin tetramethyl ether, a similar compound can be prepared, and further work in this direction is now in active progress.

138. "The electrolytic oxidation of hydroxybenzoic acids." By Arthur George Perkin and Frederick Mollwo Perkin.

Twenty grams of gallic acid were dissolved in 100 c.c. of concentrated sulphuric acid, and the solution then diluted with about one-third its volume with water and electrolysed in the anode compartment of an electrolytic cell, when about 30 per cent. of a colouring matter was obtained which had the appearance of, but was not identical with, ellagic acid; it gave an acetyl compound melting at 313—316°.

Protocatechuic acid, when treated in a similar manner, gave catellagic acid, $C_{14}H_6O_6$ (the yield being about 25 per cent.), the acetyl compound, $C_{14}H_4O_6(C_2H_3O)_2$, melted at 322—324°.

The electrolytic conditions employed were such as are generally used for preparing persulphuric acid, namely, moderately concentrated sulphuric acid and a high anode current density. By the electrolytic method, the catellagic acid obtained is purer than when potassium persulphate and sulphuric acid are employed. The reaction is being further studied, and will be extended to other hydroxybenzoic acids.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Frölich, O. Die Entwickelung der elektrischen Messungen. pp. xii + 192. Braunschweig 1905. (*Recd.* 6/6/05.)

From the Publishers.

Jenkins, J. H. B., and Riddick, D. G. Photographs to illustrate Messrs. Jenkins and Riddick's paper on "The microscopic examination of metals." Published in "The Analyst" of January, 1905. (*Recd.* 5/6/05.) From the Editorial Committee of "The Analyst."

Nobel. Les Prix Nobel en 1902. pp. 181. ill. Stockholm 1905. (*Recd.* 6/6/05.) From the Royal Academy of Sciences, Sweden.

II. *By Purchase.*

Davy, Sir Humphry, Bart. Fragmentary remains, literary and scientific, with a sketch of his life and selections from his correspondence, edited by his brother John Davy. pp. viii + 330. London 1858. (*Recd.* 2/6/05.)

Delbrück, M., und Schrohe, A. Hefe, Gärung und Fäulnis. Eine Sammlung der grundlegenden Arbeiten von Schwann, Cagniard-Latour und Kützing, sowie von Aufsätzen zur Geschichte der Theorie der Gärung und der Technologie der Gärungsgewerbe. pp. 232. ill. Berlin 1904. (*Recd.* 9/6/05.)

Groth, P. Physikalische Krystallographie und Einleitung in die krystallographische Kenntnis der wichtigsten Substanzen. Vierte Auflage. pp. xiv + 820. Leipzig 1905. (*Recd.* 9/6/05.)

Jüptner, Hanns von. Lehrbuch der physikalischen Chemie für technische Chemiker und zum Gebrauche an technischen Hochschulen und Bergakademien. I Teil. Materie und Energie. II Teil. Chemisches Gleichgewicht und Reaktionsgeschwindigkeit. pp. 194, 358. Leipzig 1904, 1905. (*Recd.* 6/6/05.)

III. *Pamphlets.*

Attwood, George. Plant for the handling and treatment of ores at the Silver Cup and Nettie L. Mines, British Columbia. (From the Minutes of Proc. Inst. of Civil Engineers, **159**, 1904—1905.)

Cameron, Alexander T. The constitution of complex salts. I. Derivatives of the sesquioxides. (From the *Proc. Roy. Soc. of Edinburgh*, **25**, 1905.)

Dixon, Harold B. The nature of explosions in gases. (From the *J. Oxford University Junior Scientific Club, June*, 1903.)

Menschutkin, Boris N. M. W. Lomonossow, der erste russische Chemiker und Physiker. (From the *Annalen der Naturphilosophie*, **4**, 1905.)

Thomsen, Julius. Ueber den relativen Wert der zur Bestimmung der Verbrennungswärme flüchtiger organischer Verbindungen benutzten kalorimetrischen Methoden. (From the *Zeit. physikal. Chemie*, **51**, 1905.)

Thomson, R. T., and Dunlop, H. On the examination of cod liver oil and other fish liver oils. Glasgow 1905.

LIST OF FELLOWS, 1905.

The List of Fellows for 1905 is now in active preparation, and no change of address received after July 31st, 1905, can be included in it.

THE LIBRARY.

The Library will be closed for Stock-taking from **Monday, August 14th**, until **Saturday, August 26th**, 1905, inclusive.

Fellows are particularly requested to return all books belonging to the Library, **not later than Wednesday, August 9th.**

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Issued 10/11/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 299.

The following are abstracts of papers received during the vacation and published or passed for publication in the *Transactions.*

139. "Synthesis from glucose of an octamethylated disaccharide. Methylation of cane sugar and of maltose." By Thomas Purdie and James Colquhoun Irvine.

When a solution of tetramethyl glucose in pure benzene containing hydrogen chloride was heated at 105—115°, water was eliminated, and the rotatory power increased. The product, when distilled under reduced pressure, was a neutral dextrorotatory syrup without multirotation, which was devoid of action on Fehling's solution. The results of combustion and of methoxyl estimation agreed with the composition of an octamethylated disaccharide. Moreover, tetramethylglucose, which was recovered by heating the compound with dilute hydrochloric acid, appeared to be the sole product of the hydrolysis. These results indicate that condensation had occurred between two molecules of tetramethylglucose in the γ-oxide form, the product being an octamethyl glucosido-glucoside, which appears to be the first example of a synthesised disaccharide of the non-reducing type, represented by cane sugar and trehalose.

140. "Studies in the acridine series. Part II. Action of methyl iodide on benzoflavine." John Theodore Hewitt and John Jacob Fox.

The authors have extended their work on 2-amino-3 : 7-dimethylacridine (*Trans.*, 1904, 85, 529) by an examination of benzoflavine

(2 : 8-diamino-3 : 7-dimethyl-5-phenylacridine). Acetylation with acetic anhydride and fused sodium acetate has furnished a *diacetyl* and small quantities of a *tetracetyl* derivative.

Diacetylbenzoflavine gives a *methiodide*, $C_{26}H_{26}O_2N_3I$; ammonia acts on this giving a *base* $C_{24}H_{23}ON_3$, one molecule of acetic acid being removed in addition to hydriodic acid.

By complete hydrolysis (that is, a removal of both acetyl groups), salts are obtained of which the *sulphate*, $(C_{22}H_{21}N_3)_2,H_2SO_4$, may be regarded as having a typical composition. The corresponding base does not contain oxygen, and since it lacks a carbinol hydroxyl its constitution must be regarded as para-quinonoid.

141. "Note on certain derivatives of *cyclo*propene."
By David Trevor Jones.

The diethyl ester of methyl*cyclo*propenedicarboxylic acid and the corresponding dimethyl ester both readily take up two atoms of bromine, ethyl dibromomethyltrimethylenedicarboxylate thus obtained being a liquid (b. p. 185°/30 mm.), whilst the dimethyl bromo-ester is a solid (m. p. 77°). When warmed with zinc and acetic acid, these additive products yielded the *cyclo*propene esters from which they were derived.

When ethyl dibromomethyltrimethylenedicarboxylate is condensed with two molecules of ethyl sodiomalonate, a non-volatile product is obtained, which, on saponification with potassium hydroxide, yields small quantities of a tribasic acid, $C_9H_8O_8$ (m. p. 222°).

The intermediate non-volatile product appears to contain ethyl methyldi*cyclo*tetranetetracarboxylate, the acid, $C_9H_8O_8$, owing its formation to the splitting of a linking by potassium hydroxide with subsequent lactone formation.

142. "Experiments on the synthesis of the terpenes. Part V. Derivatives of *ortho*-cymene." By Francis William Kay and William Henry Perkin, jun.

Terpenes belonging to the *o*-series have not previously been prepared, and the authors described a series of experiments by which many members of this group have been obtained.

143. "Experiments on the synthesis of the terpenes. Part VI. Derivatives of *meta*-cymene." By William Henry Perkin, jun., and George Tattersall.

The authors dealt with some hitherto unknown members of the *m*-series of terpenes which have been obtained from various derivatives of *m*-toluic acid with the aid of organo-magnesium compounds.

144. "Topic axes and the topic parameters of the alkali sulphates and selenates." By Alfred Edwin Howard Tutton.

The conception of "topic axes," a combination of the crystallographical axes with the molecular volume, introduced independently by Muthmann in Germany and the author in this country, has proved of great value as an expression of the fundamental morphological structure of crystals. The author's surmise, published in 1894 (*Trans.*, **65**, 659), as to the existence of relatively large interspaces between the structural units has now been proved to be a fact by the results of the determinations of the topic axes of the ammonium salts.

The importance of correctly diagnosing the type of homogeneous structure present in a crystallised substance is emphasised, and the suggestion of Fedoroff (*Zeit. Kryst. Min.*, 1902, **35**, 129), that the type present in the crystals of the alkali sulphates and selenates is a pseudo-hexagonal one, is taken up and shown to be probably in accordance with fact, although the symmetry is strictly rhombic; for the primary prism angle is less than 1° removed from 60°, and the crystals frequently show a pseudo-hexagonal habit and form pseudo-hexagonal triplets.

A new series of topic axes has therefore been calculated for these salts on the assumption of a pseudo-hexagonal space lattice, employing densities freshly determined with the aid of the suspension method for the calculation of the molecular volume involved. The results demonstrate even more elegantly the laws already published by the author, governing the relations of the morphological constants with the atomic weight of the alkali metal, and with that of the dominant negative element (sulphur or selenium) present, as also the rule regarding the position of ammonium near rubidium in the alkali series and the interesting corollary as to the existence of intermolecular and interatomic spaces.

145. "The relation of position isomerism to optical activity. IV. The rotation of the menthyl esters of the isomeric nitrobenzoic acids." By Julius Berend Cohen and Henry Percy Armes.

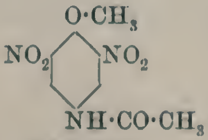
The previous observations on the effect of position isomerism on the rotation of menthyl benzoate have been confirmed. The *p*-nitro-group has the least, the *o*-nitro-group the greatest effect on the rotation, whilst the effect of the *m*-nitro-group lies between the two. The most striking difference in the effect of the nitro-group and that of the halogens previously studied (*Trans.*, 1903, **83**, 1213; 1904, **85**, 1262) is that whereas the ortho-chlorine and -bromine atoms diminish the amount of deviation, the *o*-nitro-group enormously increases it.

146. "Dinitroanisidines and their products of diazotisation." By Raphael Meldola and Frank George Coad Stephens.

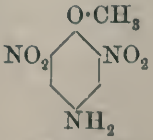
This paper is in continuation of former work on the elimination of a nitro-group on diazotisation and has been carried out in order to ascertain whether this elimination follows the ortho-para rule. The authors have found that when dinitro-*o*-anisidine is diazotised in presence of sulphuric acid and the product decomposed by heating with hydriodic acid there is obtained a mixture of a new iododinitroanisole ($C_6H_2{\cdot}OCH_3{\cdot}I{\cdot}NO_2{\cdot}NO_2 = 1:2:4:5$), melting at 146—147°, and the iodonitroresorcinol methyl ether (m. p. 115—116°) formerly described. This result shows that under the conditions of diazotisation specified there results a mixture of a diazonium salt and a quinone-diazide (diazo-oxide). By the nitration of the monacetyl derivative of *p*-aminophenol the authors have obtained, in accordance with the results recently published by Reverdin (*Arch. Sci. phys. nat.*, 1905, **19**, 353), the acetyl derivative of the *iso*picramic acid

$$(C_6H_2{\cdot}OH{\cdot}NO_2{\cdot}NH_2{\cdot}NO_2 = 1:2:4:6)$$

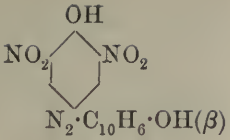
of Dabney (*Amer. Chem. J.*, 1883, **5**, 33). On methylation, this acetyl derivative yields a new dinitroacetanisidide which, on hydrolysis, gives a new dinitroanisidine:



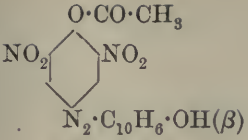
M. p. 157°.
I.



M. p. 212°.
II.



M. p. 269—270°.
III.



M. p. 259°.
IV.

The latter on diazotisation does not lose a nitro-group, but the methyl of the methoxy-group is eliminated with the formation of the dinitroquinonediazide. The latter couples with β-naphthol in alkaline solution to form the azo-compound (III), the acetyl derivative of the latter (IV) being readily formed by heating the compound for a few minutes with acetic anhydride.

The authors have also prepared the dinitroacetanisidide and dinitroanisidine corresponding to the new dinitroaminophenol recently described by Reverdin.

147. "Labile isomerism among benzoyl derivatives of salicylamide." By Arthur Walsh Titherley and William Longton Hicks.

A compound erroneously described by one of the authors (*Trans.*, 1902, **81**, 1533) as salicylbenzamide, $OH\cdot C_6H_4\cdot CO\cdot NH\cdot CO\cdot C_6H_5$, melting at 120°, which was obtained in the condensation of methylsalicylate and sodium benzamide, was shown to be a peculiar double compound of benzamide and salicylic acid, and *N*-benzoylsalicylamide has not yet been isolated. There are, however, two *o*-benzoyl derivatives of salicylamide, one melting at 208°, obtained in the above condensation, which is identical with the compound described by Gerhardt and Chiozza (*Ann. Chim. Phys.*, 1856, **46**, 139), the other (m. p. 144°) obtained by the authors by the wet benzoylation of salicylamide by benzoyl chloride in presence of sodium carbonate. Neither gives any coloration with ferric chloride and there is strong evidence that in both compounds the benzoyl group is attached to phenolic oxygen. The more fusible isomeride is labile and passes with remarkable ease into the other, the transformation in most cases being quantitative.

The change, however, is not reversible, and of the two it is the labile compound which must possess the ordinary amide structure, $BzO\cdot C_6H_4\cdot CO\cdot NH_2$, since only the stable form, *o*-benzoylsalicyliminohydroxide, $BzO\cdot C_6H_4\cdot C(OH)\colon NH$, yields metallic salts.

Both forms on benzoylation in pyridine yield the same *O*-*N*-dibenzoylsalicylamide, $BzO\cdot C_6H_4\cdot CO\cdot NHBz$ (m. p. 129°), the stable substance giving a theoretical yield, the labile isomeride furnishing a much smaller proportion owing to simultaneous production of benzoylsalicylnitrile. There is evidence of the existence of two forms of the dibenzoyl derivative in equilibrium when the stable form melting at 129° is fused. On rapidly cooling, a brittle, amorphous glass is obtained which melts at 55—60°, solidifies again at 85°, and then melts at 128°.

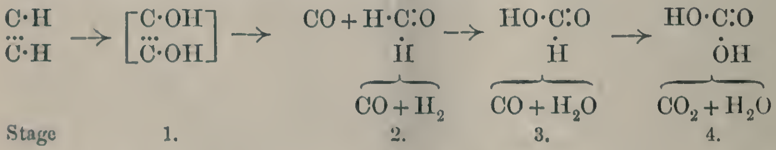
148. "Preparation of benzeneazocoumarin; its bearing on the constitution of *p*-hydroxyazo-compounds." By Herbert Victor Mitchell.

The existence, and extreme ease of formation, of benzeneazocoumarin and the three nitrobenzeneazocoumarins favours the view that the *p*-hydroxyazo-compounds are really phenolic in character and not derivatives of quinonephenylhydrazone.

149. "The combustion of acetylene." By William Arthur Bone and George William Andrew.

The authors' experiments proved that (1) the combustion of acetylene does not involve the preferential oxidation of either carbon or hydrogen. Separation of carbon or hydrogen, when it does occur, must be entirely ascribed to secondary thermal decompositions.

(2) Carbon monoxide and formaldehyde simultaneously arise at an early stage of the process, probably as the result of the decomposition of an unstable primary product $C_2H_2O_2$, such as $\begin{matrix}C\cdot OH\\ \vdots\\ C\cdot OH\end{matrix}$. The formation of formaldehyde certainly precedes that of steam. The whole process may be represented by the following scheme:



$$\begin{array}{lcccccccc} \begin{matrix}C\cdot H\\ \vdots\\ C\cdot H\end{matrix} & \rightarrow & \left[\begin{matrix}C\cdot OH\\ \vdots\\ C\cdot OH\end{matrix}\right] & \rightarrow & CO+\underbrace{\begin{matrix}H\cdot C{:}O\\ \dot{H}\end{matrix}}_{CO+H_2} & \rightarrow & \underbrace{\begin{matrix}HO\cdot C{:}O\\ \dot{H}\end{matrix}}_{CO+H_2O} & \rightarrow & \underbrace{\begin{matrix}HO\cdot C{:}O\\ \dot{O}H\end{matrix}}_{CO_2+H_2O} \\ \text{Stage} & & 1. & & 2. & & 3. & & 4. \end{array}$$

Below the ignition point, the formic and carbonic acids produced at stages 3 and 4 respectively break down, forming steam and oxides of carbon, whilst above the ignition point the formaldehyde produced at stage 2 (or possibly also the dihydroxyacetylene at stage 1) is resolved into carbon monoxide and hydrogen. The explosive combustion may therefore be represented by the empirical equation $C_2H_2 + O_2 = 2CO + H_2$ (see Bone and Cain, *Trans.*, 1897, 71, 26).

(3) Below the ignition point, excess of oxygen over and above an equimolecular proportion always retards the combustion. This was also shown to hold good above the ignition point by H. B.

Dixon in his experiments on the rates of explosion of acetylene-oxygen mixtures (*Phil. Trans.*, 1893, 184, 183).

(4) In contact with a hot catalysing surface, such as porous porcelain, acetylene unites with steam, forming acetaldehyde. This action may take place even in presence of oxygen, and introduces a complication whenever the hydrocarbon is being burnt over a hot surface. In such circumstances, the secondary decomposition of acetaldehyde might give rise to methane, or even carbon and hydrogen and carbon monoxide, thus: $CH_3{\cdot}CHO = \underbrace{CH_4}_{C + 2H_2} + CO$ (Bone and Smith, *Trans.*, 1905, 87, 910).

(5) Benzene is not produced in presence of oxygen below the ignition point.

150. "Studies on the origin of colour-derivatives of fluorene."

By Ida Smedley.

Experiments were made with the object of throwing further light on the question, under what conditions in ketonic compounds can halogens play the part of oxygen in contributing to the formation of coloured substances. The results supported the view that the power of the carbonyl group to act as a chromophore is destroyed by replacing the oxygen by two chlorine atoms; the effect of the other halogen atom requires further elucidation. Fluorenone chloride (m. p. 103°) was prepared and was found to be colourless, but attempts to replace the chlorine by iodine atoms were unsuccessful. Fluorenone, fluorenone chloride, and 9:9-dihydroxydiphenylfluorene (m. p. 223—224°) exhibit in a marked degree the property of "halochromism" when dissolved in concentrated sulphuric acid. The action of alcoholic potassium hydrosulphide on fluorenone chloride produced a colourless disulphide (m. p. 161°); the similar action of alcoholic potassium sulphide did not form a thio-ketone, as was expected, but produced the red hydrocarbon, bisdiphenylene-ethylene, and fluorenone.

151. "Note on the Zeisel reaction in the case of di-ortho-substituted phenolic ethers." By David Runciman Boyd and John Edmund Pitman.

Pyrogallol trimethyl ether is readily decomposed by aqueous hydriodic acid (sp. gr. 1·6), giving the theoretical yield of methyl iodide after heating for 45 minutes.

Trichloroanisole and tribromoanisole, on the other hand, are left for the most part unaffected by such treatment. If, however, the solubility of these ethers is secured by employing, instead of aqueous hydriodic acid, a mixture of about equal volumes of hydriodic acid with glacial acetic acid, decomposition is complete after an hour's heating, and a theoretical yield of methyl iodide is obtained.

152. "The mechanism of the hydrogen sulphide reduction of nitro-compounds." By Julius Berend Cohen and Douglas McCandlish.

In the process of reducing different nitro-compounds with ammonium sulphide, or, as it is usually effected, with hydrogen sulphide in an alcoholic solution containing ammonia, great differences are noticeable in the rate of reduction, in the conditions under which reduction takes place, and in the nature of the products formed. From a study of upwards of forty different nitro-compounds, the authors have laid down the following empirical rule: *the rate of reduction is increased by the presence of acidic* (NO_2, CO_2Me, Cl) *groups and diminished by that of basic groups* (CH_3, NH_2), *and is further affected by steric hindrance.* The authors show further that the reduction occurs in at least two well-defined steps, the first being attended by the formation of a hydroxylamine compound, which is easily identified by its property of liberating iodine from potassium iodide.

153. "The arylsulphonyl-*p*-diazoimides." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

The new series of arylsulphonyl-*p*-diazoimides (*Trans.*, 1905, 87, 74 and 921) has been extended by the preparation and investigation of *toluene*-p-*sulphonyl*-p-*phenylenediazoimide*, 1 : 3-*xylene*-4-*sulphonyl*-p-*phenylenediazoimide*, and the more complex *benzene*-1 : 3-*disulphonylbis*-p-*phenylenediazoimide*, $C_6H_4\!:\![N_3]\cdot SO_2\cdot C_6H_4\cdot SO_2\cdot [N_3]\!:\!C_6H_4$.

A detailed examination of the first of these compounds showed that (1) the molecular complexity of the arylsulphonyl-*p*-diazoimides corresponds with the simplest empirical formula for these substances; (2) cold mineral acids and even glacial acetic acid bring about a disruption of the *p*-diazoimido-complex; (3) the *p*-diazoimides readily yield azo-derivatives when condensed in an inert solvent with the phenols and the more reactive aromatic amines, and (4) when treated with caustic alkalis, preferably in alcoholic solution, the diazo-nitrogen of these diazoimides is eliminated and replaced by hydrogen.

154. "The reversibility of photographic development and the retarding action of soluble bromides." By Samuel Edward Sheppard.

It was shown experimentally that development is a *reversible* chemical reaction, and for ferrous oxalate the equilibrium factors were determined quantitatively. The retarding action of bromides enabled the parts played by diffusion and chemical action to be defined, and a general theory of development on this basis was brought forward.

155. "Studies in chlorination. III. The progressive chlorination of benzene in presence of the aluminium-mercury couple." By Julius Berend Cohen and Percival Hartley.

In the present paper a description is given of the products obtained by the progressive chlorination of benzene from the monochloro- to the pentachloro-derivative. The results confirm the general rule which has been found to obtain in the case of the chlorotoluenes and the chloronitro-derivatives of benzene and toluene (*Trans.*, 1902, **81**, 1326, 1345; 1904, **85**, 1276; 1905, **87**, 320), and which may be expressed as follows:

The third substituent (chlorine atom or nitro-group) entering the dichloro- or chloronitro-benzenes or the monochlorotoluenes occupies the unsymmetrical position, forming a 1 : 2 : 4-compound; the fourth substituent (Cl or NO_2) occupies position 5.

In all the vicinal (1 : 2 : 3) chloro- or chloronitro-derivatives of benzene and toluene, the fourth substituent (Cl or NO_2) is adjacent to the other three.

There is no marked exception to this rule, which, in the majority of cases, has reference to the only product of the reaction in question; in a few cases to the main product.

156. "The interaction of sulphuretted hydrogen and arsenic pentoxide in the presence of hydrochloric acid." By Francis Lawry Usher and Morris William Travers.

It has been found that in absence of hydrochloric acid, or in presence of very small quantities of that reagent, arsenic pentoxide is rapidly reduced, so that the reaction results in the formation of the trisulphide. With increasing concentrations of the acid, up to 25 per cent. strength, the product is the pentasulphide. In the case of the reaction between arsenic pentoxide and sulphur dioxide in solution, hydrochloric acid exerted a similarly marked influence in retarding the rate at which the reduction took place.

In presence of concentrated hydrochloric acid, the reaction results in the formation of the trisulphide. It was proved that in this case one has to consider the reaction of the arsenic pentoxide with the hydrochloric acid as taking place much more rapidly than that which would result in the formation of the pentasulphide. The reaction of the arsenious compound and the chlorine with the sulphuretted hydrogen is practically instantaneous.

157. "Studies in asymmetric synthesis. III. The asymmetric synthesis of *l*-lactic acid. The optical activity of fermentation lactic acid." By Alexander McKenzie.

Samples of fermentation lactic acid from various firms were examined polarimetrically and found to be sometimes dextrorotatory and sometimes lævorotatory. The author supposed that a mixture of unequal amounts of *d*- and *l*-lactic acids is invariably produced in the production of lactic acid from sugar by bacterial agency. Active lactic acid is not so readily racemised by alkali as is active mandelic acid.

The asymmetric synthesis of *l*-lactic acid was accomplished by reducing *l*-menthyl pyruvate with aluminium amalgam, when a mixture of unequal amounts of *l*-menthyl *d*-lactate and *l*-menthyl *l*-lactate, containing an excess of the latter, is formed. When this mixture is hydrolysed by an excess of alcoholic potassium hydroxide and the *l*-menthol removed, a dextrorotatory potassium salt, containing an excess of *l*-lactate over *d*-lactate, is produced; this mixture, on acidification by a mineral acid, becomes lævorotatory and forms a dextrorotatory zinc salt.

158. "The action of phenylpropiolyl chloride on ketonic compounds." By Siegfried Ruhemann and Richard William Merriman.

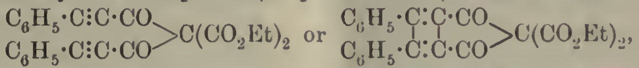
By the action of phenylpropiolyl chloride on the mono-sodio-derivative of ketonic compounds, the acetylenic ketones are not formed, but compounds which are shown to be derivatives of dihydrofurfuran. With the acid chloride, thus mono-sodioacetylacetone yields acetylbenzylidenemethylketodihydrofurfuran (m. p. 152—153°).

Although insoluble in alkali hydroxides or carbonates, this compound is readily decomposed by these reagents. In secondary bases, such as piperidine, it dissolves with development of heat to yield deep blue solutions, from which hydrochloric acid precipitates an isomeric substance, 2-acetyl-5-hydroxy-4-phenyl-3-methyl-1-keto*cyclo*pentadiene (m. p. 170°), crystallising from alcohol in red plates.

This red isomeride has acidic properties, dissolving in piperidine and alkali hydroxides or carbonates, yielding blue solutions, in which, however, it is very unstable, the colour changing to yellow, slowly in the cold but readily on warming. The solution then yields, with hydrochloric acid, the colourless acetylphenylmethyl*cyclo*butadienecarboxylic acid, also isomeric with the former compounds. Under the influence of cold concentrated sulphuric acid, the acid is transformed into an orange compound (m. p. 216—217°), to which the name indone*cyclo*methylacetoethylene has been given. This substance dissolves in aqueous alkalis, especially on warming, yielding violet solutions.

Ethyl 5-benzylidene-2-methyl-4-ketodihydrofurfuran-3-carboxylate, the product of the action of phenylpropiolyl chloride on ethyl monosodioacetoacetate, is analogous to the yellow compound, $C_{14}H_{12}O_3$; it also dissolves in piperidine to yield a blue solution from which hydrochloric acid precipitates a red solid similar in properties to the red compound, $C_{14}H_{12}O_3$.

The action of phenylpropiolyl chloride on ethyl mono-sodiomalonate furnished a yellow compound (m. p. 174—175°), which is either



$$\left.\begin{array}{l}C_6H_5{\cdot}C{\vdots}C{\cdot}CO\\ C_6H_5{\cdot}C{\vdots}C{\cdot}CO\end{array}\right>C(CO_2Et)_2 \text{ or } \left.\begin{array}{l}C_6H_5{\cdot}C{:}C{\cdot}CO\\ \phantom{C_6H_5{\cdot}}\,|\;\;\;|\\ C_6H_5{\cdot}C{:}C{\cdot}CO\end{array}\right>C(CO_2Et)_2,$$

together with the anhydride of 1 : 2-diphenyl*cyclo*butadiene-3 : 4-dicarboxylic acid.

159. "The influences regulating the reproductive functions of *Saccharomyces cerevisiæ*." By Adrian John Brown.

The paper described the results of a continued investigation of phenomena associated with the reproductive functions of the yeast-cell to which attention had been previously called by the author (Trans., 1892, **61**, 369; and 1894, **65**, 911).

160. "Molecular refractions of some liquid mixtures of constant boiling point." By Ida Frances Homfray.

Mixtures of aldehyde and water give values of specific refraction less than those calculated from the constituents, and these differences form a regular series passing through a maximum. The molecular refraction of aldehydrol, $CH_3{\cdot}CH(OH)_2$, should be less than that of acetaldehyde *plus* water, on account of the change of the oxygen atom from the carboxylic to the hydroxylic condition. The presence of aldehydrol, together with free aldehyde and water, is therefore confirmed, and an approximate estimate of the relative amounts has been made.

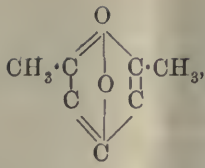
Formic acid and water do not appear to combine at the ordinary temperature to form orthoformic acid. Acetone and water show a partial, but only slight, tendency to combination as $CH_3{\cdot}C(OH)_2{\cdot}CH_3$.

Gautier has given reasons for considering that a definite chemical compound is formed, consisting of one molecule of ethyl cyanide and three of alcohol, and that this is the distillate obtained in preparing ethyl cyanide by Pelouze's method.

The refractive indices of a number of mixtures of different concentrations have now been measured and the experimental curve so constructed used to determine the composition of the distillates under atmospheric pressure and under a series of lower pressures. In the former case, Gautier's result is confirmed, but when the pressure is reduced, the distillate contains more cyanide. The density and specific and molecular refractions of the mixture agree with those calculated from the constituents.

The conclusion is, therefore, that no compound is formed, and that this is a case of mutually soluble liquids of maximum vapour pressure. Cryoscopic determinations in benzene gave normal depression in the case of ethyl cyanide, but small values for alcohol and for the mixture of constant boiling point. Reasons are, however, given for attributing this, in both cases, to reduction of osmotic pressure rather than to molecular association or combination.

161. "Molecular refractions of dimethylpyrone and its allies, and the quadrivalency of oxygen." By Ida Frances Homfray.

In most cases of associated compounds containing oxygen, the quadrivalency of that element is probable, and the observed molecular refractions are always in excess of those derived from the additive constants. The inference is that the atomic refraction of quadrivalent oxygen is greater than the highest of the values for the bivalent atom. No satisfactory data have been published for the determination of this constant, and the compounds which appear to afford the best opportunity for such investigation are dimethylpyrone and its allies and derivatives. Accordingly, the molecular refractions of the following easily purified substances have been determined, and all data are given. Dimethylpyrone and its hydrochloride, the compound of dimethylpyrone and alcohol, diacetylacetone, pyrone and its hydrochloride, pyromeconic acid, ethyl chelidonate, ethyl xanthochelidonate, and dehydracetic acid. Measurements were made in solution in various solvents, the specific refraction of the solute being deduced in the usual way. The possible error is estimated at about one per cent. When the usual formulæ, not involving quadrivalent oxygen, are used, the calculated molecular refractions are in all cases considerably too low. The modified formula for dimethylpyrone proposed by Professor Collie is , and all the other compounds examined here may be expressed by analogous formulæ. The atomic refraction of quadrivalent oxygen for the D-spectral line required by these formulæ to satisfy the experimental numbers has been found by subtraction in each case, and a good agreement between these values is obtained, the mean being 2·73.

The molecular refractions recalculated with this number for quadrivalent oxygen agree in most cases with the experimental to within the limit of accuracy of measurement.

162. "The alkylation of mannose." By James Colquhoun Irvine and Agnes Marion Moodie.

α-Methylmannoside has been alkylated in methyl-alcoholic solution by means of silver oxide and methyl iodide with the production of a crystalline tetramethyl α-methylmannoside, and this compound, when hydrolysed by means of dilute hydrochloric acid, was converted into tetramethyl mannose.

The alkylated sugar proved to be a colourless syrup, and when heated with methyl alcohol containing 0·25 per cent. hydrochloric acid it behaved like mannose, producing only the α-modification of the corresponding mannoside. Consequently the crystalline tetramethyl α-methylmannoside was the sole product of the reaction. When the alkylation was effected by means of silver oxide and methyl iodide, however, a different result was obtained. The product was a colourless, lævorotatory liquid, and this was shown to consist of a mixture of the α- and β-modifications of the fully methylated methylmannoside. The β-isomeride differs from the α-form in its lævorotation and in its ready hydrolysis by means of dilute hydrochloric acid or by the action of emulsin.

163. "The interaction of acridines with magnesium alkyl halides." By Alfred Senier, Percy Corlett Austin, and Rosalind Clarke.

By the application of Grignard's reaction to acridine and its homologues, a series of coloured crystalline compounds has been obtained. Endeavours to replace the metal magnesium by calcium were, however, unsuccessful, for in attempting to prepare calcium alkyl and aryl halides a change resembling Fittig's reaction always occurred almost exclusively (compare Beckmann, *Ber.*, 1905, **38**, 904). The magnesium compounds, although readily formed, were very difficult to obtain in a pure state on account of their insolubility in inert solvents, and they were decomposed by glacial acetic acid, alcohol, and chloroform, the alcoholic solution yielding the original acridine.

On employing as solvents for the reagents ethers of high boiling points, such as anisole and phenetole, or mixtures of either of these with ordinary ether, compounds of definite composition slowly crystallised. These products, which frequently change in colour on drying, retain variable proportions of ether, but this can be entirely removed by drying at 110—115°.

Most of the compounds examined were of the type of the diacridine hexahalides previously described (*Trans.*, 1904, **85**, 1199), and consist of two molecules of the base united with three molecules of the "reagent." In the case of hexamethylacridine, however, the type is that of the tetrahalides, one molecule of base combining with two of the "reagent."

164. "New method of determining molecular weights."

By Philip Blackman.

Isotonic solutions of different substances in the same solvent having equal vapour pressures, it follows that if two solutions connected by vapour be allowed to attain equilibrium, their final volumes (v_1, v_2) will be inversely proportional to the number of dissolved molecules. This state of equilibrium is represented by the equation $\frac{m_1}{m_2} = \frac{w_1}{w_2} \cdot \frac{v_2}{v_1}$ (where m_1, m_2, are the molecular weights of the substances, the weights, w_1, w_2, of which are dissolved in the volumes, v_1, v_2, of the same solvent).

The apparatus consists of two graduated test-tubes connected by a T-piece, with a bulb in each of the limbs of the U-piece. The substances are introduced into the test-tubes, the solvent added, and the solutions boiled. After a time, several readings of the volumes (v_1, v_2) are taken, and the molecular weight calculated from the foregoing equations. With careful boiling, good results can be obtained in remarkably short times.

165. "Benzylphenylallylmethylammonium compounds. A complete series of four optically active salts." By Alfred William Harvey.

l-Benzylphenylallylmethylammonium *l*-camphorsulphonate has been prepared, having a molecular rotatory power of an equal arithmetical value to that of its dextro-isomeride, and a series of salts of the optically active base combined with optically active camphorsulphonic acids have been obtained of the type:

$$dBdA\,;\ lBlA\,;\ dBlA\,;\ lBdA.$$

The method of effecting the resolution of the iodide of the externally compensated base has been somewhat modified, whereby the difficulties previously experienced have been obviated (compare *Trans.*, 1899, **75**, 1127, and 1901, **79**, 828).

166. "Solid solutions." By Reinhold Frederick Korte.

Experiments were made to determine whether barium sulphate precipitated in presence of a ferric salt forms a solid solution of ferric iron, or whether a ferrisulphate of barium is produced. The results showed that the amount of iron carried down with the barium sulphate does not increase in weight above a very small amount (about 1·3 per cent.), however much of the ferric salt be present; also that there is a loss on ignition, implying the decomposition of an iron sulphate. Probably the point of saturation of barium sulphate with ferric iron is one in which the latter is present to only a minute extent, and it is also not impossible that the state of the ferric salt is that of a ferric sulphate.

The precipitation of calcium as oxalate in presence of salts of magnesium was next examined. Here, when the proportion of magnesium to calcium oxide exceeds 36MgO to 5CaO, a sudden rise in the proportion of magnesium to calcium takes place, from about 4·7 to 13·7 per cent. The magnesium is evidently present in the state of solid solution, and, although magnesium oxalate is an easily soluble salt, yet it cannot be removed from the calcium oxalate precipitate by washing.

In precipitating ferric hydroxide with ammonia in presence of a manganous salt, saturation of the ferric hydroxide with manganese takes place, when the proportion between Fe_2O_3 and MnO in solution is 5:1. A larger proportion of manganese in solution produces no change in the amount retained by the ferric precipitate, namely, 2 per cent. The absorption of small amounts of manganese by iron is nearly complete, being as much as 95 per cent. From this it follows that on redissolving and reprecipitating a ferric precipitate containing only a small proportion of manganese, little change in its composition takes place.

Ferric hydroxide also dissolves nickelous oxide, and a saturated solution is produced when the proportion between Fe_2O_3 and NiO in solution is 5·9 to 1.

Although manganous and nickel oxides are carried down with aluminium hydroxide, no regularity could be observed; solid solution appears not to take place, but merely mechanical absorption by the gelatinous alumina.

Lead sulphate, precipitated in presence of other salts, does not carry down any metals in solid solution.

167. "The bromo-derivatives of camphopyric acid." By John Addyman Gardner.

When *cis*-camphopyric acid is treated with bromine in the presence of phosphorus pentachloride and the mixture poured into water, the chief products are *cis*-bromocamphopyric acid and *cis*-bromocamphopyric anhydride, a small quantity of *trans*-bromocamphopyric acid being also formed.

If, however, camphopyric anhydride is used instead of camphopyric acid, the chief products are *trans*-bromocamphopyric acid and bromocamphopyric anhydride, little or no *cis*-bromocamphopyric acid being produced.

trans-Camphopyric acid, treated in a similar way, using phosphorus trichloride instead of pentachloride, yields mainly *cis*-bromocamphopyric acid, a little anhydride, but no *trans*-bromo-acid.

The *cis*-acid is readily convertible into its anhydride by the action of acetyl chloride, but the *trans*-acid is not affected by this reagent. On the other hand, *cis*-bromocamphopyric anhydride, on boiling with water, is converted into a mixture of *trans*-bromocamphopyric acid and decomposition products, probably of the *cis*-acid.

The bromine atom is readily replaceable. By the action of nascent hydrogen, *trans*-bromocamphopyric acid yields *trans*-camphopyric acid, whilst both *cis*-bromocamphopyric acid and *cis*-bromocamphopyric anhydride give ordinary camphopyric acid. Under the influence of alkalis, the bromine atom in both acids may be replaced by hydroxyl.

168. "The reduction of metallic oxides by aluminium carbide." By John Norman Pring.

Alloys of aluminium can be prepared by direct reduction of the oxide by carbon in presence of many other metals, whereas without such auxiliary metals the product consists chiefly of aluminium carbide. These considerations led to a detailed study of the reactions between aluminium carbide and metallic oxides and metals. It was found that the carbide behaves as a strong reducing agent. Up to 1400°, both the aluminium and the carbon are simultaneously oxidised, forming alumina, carbon dioxide, and the metal of the oxide. At higher temperatures, however, selective reduction becomes apparent, the reduction being more and more brought about by the carbon of the carbide the higher the temperature of reaction, the result being that alloys of aluminium and the reduced metal are obtained, the percentage of aluminium increasing with the temperature and, in the case of iron, finally reaching the limit demanded by the equation

$$Fe_2O_3 + Al_4C_3 = 2Fe.\quad 4Al + 3CO.$$

Calcium carbide was found to exhibit a similar behaviour, but to a less marked degree, interaction between lead oxide and excess of molten calcium carbide giving an alloy containing 2·6 per cent. of calcium.

Aluminium carbide reacts with metals at temperatures above the melting point of platinum to form aluminium alloys with liberation of free carbon; at higher temperatures, the reaction takes place with violence and is complete.

A study of the action of metallic calcium on aluminium carbide showed that calcium carbide is formed at all temperatures above the melting point of platinum, and as aluminium acts on calcium carbide producing aluminium carbide, the reaction is probably reversible.

169. "The rusting of iron." By Wyndham Rowland Dunstan, Hooper Albert Dickinson Jowett, and Ernest Goulding.

A detailed account is given of the investigation on the rusting of iron, an outline of which has been already published (Dunstan, Proc., 1903, **19**, 150).

170. "Studies in comparative cryoscopy. Part III. The esters in phenol solution." By Philip Wilfred Robertson.

The molecular depressions of the esters in phenol solution tend to increase with the concentration. In many instances, however, there is an initial association, that is, the molecular depression first decreases, so that under these conditions a minimum is exhibited in the molecular depression curve.

The concentration at which the minimum occurs is a characteristic for each ester, but is greater in the case of esters of high molecular weight. The initial association of these compounds becomes more rapid as the molecular weight increases.

The ethyl esters of the normal fatty acids differ from odd to even members of the series, but each division forms a perfectly definite series. Thus, in the case of the compounds with an even number of carbon atoms, the initial molecular depression reaches a maximum at the sixth member, falls to a minimum at the twelfth, and then rises to a second maximum when the chain contains sixteen carbon atoms.

The esters derived from polybasic acids are characterised by the following behaviour.

(1) Their molecular depressions increase rapidly with the concentration.

(2) The minimum in the molecular depression curve is not always exhibited.

(3) They have extremely high initial molecular depressions.

The negative "rate" of association and the abnormally high molecular depressions of the esters are probably due to the great tendency of phenol to form molecular complexes, since, in the case of the substituted phenols, thymol, guaiacol, and *o*-nitrophenol, which are not so strongly associated, these irregularities tend to disappear.

171. "The iodides of copper."

By James Wallace Walker and Mary Violette Dover.

When equivalent solutions of potassium iodide and copper sulphate are mixed, the resulting precipitate seems to contain a definite polyiodide of copper mixed with the cuprous iodide, and not, as has been hitherto assumed, free iodine. Treatment of this precipitate with water gives a deep red solution, the analyses of which point to the formula CuI_4 for the solid polyiodide. From a study of the equilibrium between this solution and cuprous iodide, the authors conclude that it contains an equimolecular mixture of CuI_2 and CuI_6. The limit of concentration of pure cupric iodide solution is almost exactly 0·1 per cent., removal of the water even in the form of ice inducing the reaction $6CuI_2 \rightleftharpoons CuI_6 + 5CuI$. Even higher polyiodides than these can be obtained from alcoholic solution.

172. "The interaction of alcohols and phosphorous halides."

By James Wallace Walker and Frederick Murray Godschall Johnson.

The authors have studied the yield of alkyl halide obtained in the action of phosphorous chloride, bromide, and iodide on methyl, ethyl, and *n*-propyl alcohols, in the hope of finding a general equation such as $PX_3 + 3A{\cdot}OH = P(OA)_{3-y}(OH)_y + (3-y)HX + yAX$, applicable to the several cases. In this equation, X represents a halogen atom and A an alkyl group. In the production of methyl and *n*-propyl bromides and of ethyl iodide, the value of y is 2; in the case of ethyl chloride, it is 1. In the other instances, the above equation would require to be doubled to express the results. The high degree of solubility of yellow phosphorus in methyl iodide suggested a ready method for the production of that substance in quantity. The theoretical weight of iodine is added to a 10 per cent. solution of phosphorus in methyl iodide, and the equivalent amount of alcohol is slowly introduced. Enough phosphorus is then dissolved in the resultant liquid to produce again a 10 per cent. solution and iodine and alcohol are added as before. By continuing this process a large quantity of methyl iodide may be obtained in a short time, the yield being 94 per cent. of the theoretical. Only 65 per cent. of the theoretical yield of ethyl iodide was obtained by this method. Instead of employing the phosphorus and iodine in the ratio required for the production of the tri-iodide, an almost equally good result is obtained by adding enough iodine to produce the penta-iodide, this compound being much more soluble than the tri-iodide in methyl iodide.

173. "The electrical conductivities of some salt solutions in acetamide." By James Wallace Walker and Frederick Murray Godschall Johnson.

The salts examined were mercuric chloride, potassium chloride, iodide, and cyanide. Of these, the first is the only normal electrolyte, the others showing a maximum of molecular conductivity at about 30 or 40 litres, which then falls to about half value on dilution. Mercuric chloride is known to give a compound with acetamide and potassium iodide is found to yield the compound $KI,6CH_3{\cdot}CO{\cdot}NH_2$. The migration ratio of the iodion is found to be greater than in aqueous solution a fact which points to combination of the ions with the solvent.

174. "Contributions to our knowledge of the aconite alkaloids. Part XVI. Indaconitine, the alkaloid of *Aconitum chasmanthum*." By Wyndham Rowland Dunstan and Albert Edward Andrews.

Indaconitine is a highly poisonous alkaloid which has been obtained from the Indian plant known as "mohri," at first thought to be the same as the European *Aconitum Napellus*, but now recognised as a distinct species, *Aconitum chasmanthum*. In this paper a full account is given of the properties of the alkaloid and of its principal salts.

Indaconitine ($C_{37}H_{47}O_{10}N$) is a crystalline alkaloid very closely resembling aconitine from *Aconitum Napellus* in its general properties, but differing, however, in its habit of crystallisation and in many of its physical properties. Most of the salts crystallise well and are distinct from the corresponding aconitine salts. Its physiological action has been shown to closely resemble that of aconitine and pseudaconitine (Cash and Dunstan, *Proc. Roy. Soc.*, 1905).

Indaconitine undergoes hydrolysis in two stages, in the first of which an acetyl group is eliminated as acetic acid, with the formation of a base, indbenzaconine, which has not been crystallised, but furnishes crystalline salts. This hydrolysis is represented by the equation:

$$C_{34}H_{47}O_{10}N + H_2O = C_2H_4O_2 + C_{32}H_{45}O_9N.$$

Indbenzaconine is practically non-poisonous. On further hydrolysis, indbenzaconine furnishes benzoic acid and pseudaconine identical with the final hydrolytic product of pseudaconitine.

Indaconitine is therefore of interest as representing a type of highly toxic alkaloid intermediate in its properties between the aconitine of the common European aconite (*A. Napellus*) and the pseudaconitine derived from the Indian aconite of Nepal. The discovery of this alkaloid and its proximate constitution has led the authors to change the formula of pseudaconitine from $C_{36}H_{49}O_{12}N$, the formula originally assigned to the alkaloid by Wright, to $C_{36}H_{51}O_{12}N$.

175. "Contributions to our knowledge of the aconite alkaloids. Part XVII. Bikhaconitine, the alkaloid of *Aconitum spicatum*." By Wyndham Rowland Dunstan and Albert Edward Andrews.

This alkaloid, like indaconitine described in the previous communication, is highly poisonous. It has been isolated from a supposed variety of *Aconitum ferox* of India, which has now been proved to be a distinct species, *Aconitum spicatum.* The vernacular name of the plant being "bikh," the name bikhaconitine is proposed for the new base.

Bikhaconitine ($C_{36}H_{51}O_{11}N$) does not crystallise so readily as other "aconitines," and its physical properties are distinct. A number of its salts have been prepared, and most of them crystallise well. Its physiological action very nearly resembles that of the other aconitines: its toxicity towards warm-blooded animals is greater than that of either aconitine or japaconitine, but is slightly inferior to that of pseudaconitine, which is the most poisonous alkaloid of the group.

Bikhaconitine, like the other aconitines, undergoes hydrolysis in two stages. In the first of these, an acetyl group is eliminated as acetic acid, forming a new base (veratroylbikhaconine). This alkaloid does not crystallise, but furnishes crystalline salts. On further hydrolysis, veratroylbikhaconine furnishes veratric acid and bikhaconine, which does not crystallise, but furnishes crystalline salts. This alkaloid differs from other "aconines" previously described.

The paper contains a full account of the properties of bikhaconitine, its salts and derivatives, and a comparison of their properties with those of the other aconitines which have been previously described. The formula of bikhaconitine differs from that of pseudaconitine by one atom of oxygen.

176. "Contributions to our knowledge of the aconite alkaloids. Part XVIII. The aconitine group of alkaloids." By Wyndham Rowland Dunstan and Thomas Anderson Henry.

This paper gave a general account of the properties of the several closely allied "aconitines" which have been described in the course of the present investigation, and also of the non-poisonous alkaloids obtained from varieties of aconite. It is pointed out that now that it has been established that closely related Indian aconites furnish similar, but nevertheless quite distinct, toxic alkaloids, it is most desirable that a similar examination should be made of the European aconites of the type of *Aconitum Napellus.* The work of Wright, Jurgens, and other chemists, as well as that of the present investigators, renders it highly probable that an examination of European plants commonly classed as *Aconitum Napellus* will reveal the presence of alkaloids very closely resembling, but yet distinct from, aconitine. The evidence already recorded goes to show that the aconitine isolated by Wright from English plants and analysed by him and others, which was described in the course of the present investigation, is a distinct substance from the aconitine of German origin which is now an article of commerce.

Thursday, November 2nd, 1905, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Messrs. W. B. Tuck, J. W. White, and E. W. Bealey were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Adam Lawson Kelly Adam, 296, Bath Street, Glasgow.
C. Chester Ahlum, Lansdale, Pennsylvania, U.S.A.
James Edward Alcock, 42, Gill Street, Moston Lane, Blackley.
James Albert Allison, Luchana Laboratory, Apartado 45, Bilbao, Spain.
George Henry Barbrook, Stowmarket, Suffolk.

Marmaduke Barrowcliff, 25, Priory Road, Kew, Surrey.
John Coggin Brown, B.Sc., Fairleigh, Cockton Hill, Bishop Auckland.
Joseph Edward Coates, B.Sc., Sunny Side, Oakamoor, Stoke-on-Trent.
Douglas Henry Bellars Cowman, Heathville Corner, Gloucester.
Arthur Augustine Dallman, Lyndhurst, Prospect Vale, Liverpool.
John Llewelyn Davies, B.A., 8, Rugby Road, Neath.
John Doull, 8, Lauriston Place, Edinburgh.
John Beaconsfield Gall, Knoxland, Erith Road, Belvedere, Kent.
Sidney Montague Haig, St. Edmund's Ave., Port Hill, Stoke-on-Trent.
Alfred Hart, M.A., B.Sc., Norman Avenue, Hawksburn, Victoria, N.S.W.
Jack Vernon Johnson Hayman, Tringhurst, Cranleigh, Surrey.
John Michael Higgins, 39, Queen Street, Melbourne, Australia.
William Basil Hill, Eastfield, Stockton Lane, York.
Isaac Berkwood Hobsbaum, 79, Claremont Road, Forest Gate, E.
Cecil Hollins, 34, Beamsley Road, Frizinghall, Yorks.
Maurice Brooks Jack, 66, Burma Road, Clissold Park, N.
Edward Towyn Jones, B.Sc., 17, Bloomsbury Square, W.C.
Rudolph Lyon, 400, Huddersfield Road, Halifax.
William McCleary, 61, Station Road, Pendlebury, Manchester.
Robert Drysdale MacKechnie, c/o Messrs. A. Boake, Roberts and Co., Ltd., Stratford, E.
Harry Martin, 14, Hardman Street, Liverpool.
Harry George Fletcher Micklewright, B.A., 116, St. James's Rd., Croydon.
Edalji Manekji Modi, opposite Grant Road Station, Bombay.
John Motion, Edgewater, New Jersey, U.S.A.
Henry Allen Dugdale Neville, B.Sc., 81, Revidge Road, Blackburn.
Francis Richard Penn, Highthorne Terrace, Shadwell Lane, Moortown, Leeds.
Hugh Donald Perkins, Dodwell, Bursledon, Hants.
Percy Barker Phipson, c/o J. Staples and Co., Ltd., Wellington, N.Z.
Frederick John Pooler, B.Sc., The Boys' High School, Grahamstown, Cape Colony, South Africa.
James Frederick Fothergill Rowland, B.A., 5, St. James's Pk., Croydon.
Harold Marmion Royle, 12, Barfield Villas, George Lane, S. Woodford.
Harry Nestor-Schnurmann, Corinth House, Cheltenham.
Douglas Temple Setterington, 45, Regent Road, Blackpool.
John Booty Tillott, 55, Wood Street, Westminster, S.W.
Frank Tutin, 49, The Avenue, Kew, Surrey.
George Stanley Walpole, 349, Queen's Road, Battersea Park, S.W.
John Ledger White, D.Sc., 73, Cambridge Mansions, Battersea Pk., S.W.
Gerard William Williams, B.A., P.O. Box, 21, Germiston, Transvaal, S. Africa.

The PRESIDENT referred to the loss sustained by the Society in the death of Professor P. T. Cleve, who was elected an Honorary and Foreign Member in February, 1883, and who died on June 18th, 1905; also in the death of Mr. G. B. Buckton, F.R.S., who was elected a Fellow in March, 1852.

Of the following papers, those marked * were read:

*177. "Molecular conductivity of water." By Philip Blackman.

The molecular conductivity of water may be represented by K and calculated from the equation

$$\mu v_{\mathrm{HX}} + \mu v_{\mathrm{M_1OH}} - \mu v_{\mathrm{M_1X}} = K.$$

The value of K is dependent on (1) temperature, (2) molecular concentration, and (3) nature of the acid (μv_{HX}, $\mu v_{\mathrm{M_1OH}}$, $\mu v_{\mathrm{M_1X}}$ represent respectively the molecular conductivities, measured at the same temperature and molecular concentration, v, of the acid HX, the base M_1OH, and the salt M_1X).

The conclusion is drawn that the greater the value of K the stronger is the acid (taking into consideration (1) the temperature and (2) the molecular concentration). This furnishes a method for determining the relative strengths of acids.

*178. "The stereoisomerism of substituted ammonium compounds."
By Humphry Owen Jones.

The existence of Wedekind's isomeric α- and β-phenylbenzylmethylallylammonium iodides is so difficult to reconcile with the absence of isomerism in all the other compounds of the same type that the author has examined these compounds in the hope of obtaining some information about this unique example of isomerism, and has found that the two compounds are not isomerides, but different compounds.

The β-compound dissociates partially into benzyl iodide and tertiary amine in chloroform solution, but is not transformed into the α-compound; it is also completely converted into phenyltrimethylammonium iodide when heated at 100° with methyl iodide in molecular proportions, whereas the α-compound requires twice as much methyl iodide to convert it into phenyltrimethylammonium iodide and benzyl and allyl iodides. Analysis and a comparison of properties prove conclusively that the β-compound is *phenylbenzyldimethylammonium iodide.*

The analyses of the compound previously given by Wedekind and by Hantzsch and Horn are incorrect, and the reactions described by the last-mentioned chemists can only have been obtained with impure material.

The reaction between benzylallylaniline and methyl iodide in the cold is expressed by the equation $C_7H_7\cdot NPh\cdot C_3H_5 + 2CH_3I = NPhMe_2(C_7H_7)I + C_3H_5I$, and at 100° by the equation $C_7H_7\cdot NPh\cdot C_3H_5 + 3CH_3I = NPhMe_3I + C_3H_5I + C_7H_7I$.

At present optical activity is the only evidence of stereoisomerism of quinquevalent nitrogen compounds of the type NabcdX, and, since the search for isomerides has been so thorough, it is concluded that no isomerides can be produced by the union of tertiary amines and alkyl iodides.

The hypothesis suggested by the author (*Trans.*, 1903, **83**, 1403) to account for the non-formation of isomeric quinquevalent nitrogen derivatives from tervalent compounds is now adequate to explain all the known facts and has been further developed.

DISCUSSION.

Mr. A. W. HARVEY stated that he had prepared considerable quantities of benzylphenylmethylallylammonium iodide, and that when the compound is produced by mixing molecular quantities of carefully purified benzylmethylaniline and allyl iodide in an equal volume of mixed methyl and ethyl alcohols (1—9) no trace of Wedekind's β-compound is formed; the reaction goes quite quantitatively, and yields a clean and pure solid product.

Dr. JONES, in reply, said that the β-compound was not produced together with the α-salt when allyl and benzyl iodides were added to the corresponding tertiary amines, but only when methyl iodide was used.

In reply to a question by Dr. Lapworth, the author stated that the evidence for the replacement of allyl by methyl in benzylallylaniline by the action of methyl iodide in the cold was quite conclusive, the benzyl group being only removed on heating.

*179. "Note on the fluorides of selenium and tellurium."

By Edmund Brydges Rudhall Prideaux.

The fluorides of selenium and tellurium are both gaseous substances prepared by the action of fluorine on the elements, their densities corresponding to the formulæ SeF_6 and TeF_6 respectively. They are easily condensable by cold alone, forming white, snow-like solids, the vapour pressure curves of which will be published shortly along with an account of the other properties of the gases.

DISCUSSION.

Mr. BLISS asked whether the author could give any further information as to the nature of the solid fluorides isolated by Moissan.

Mr. PRIDEAUX, in reply, said that the solid fluoride of tellurium left in the reaction tube may be the tetrafluoride, TeF_4, described as being obtained by the action of hydrogen fluoride on tellurous acid, but is more probably an oxyfluoride.

*180. "The constitution of glutaconic acid." By Jocelyn Field Thorpe.

The "double bond" in glutaconic acid, $CO_2H\cdot CH_2\cdot CH\colon CH\cdot CO_2H$, is apparently not fixed, since the reactions of this substance clearly indicate that it possesses a symmetrical structure.

Thus $\alpha\beta$-dimethylglutaconic and $\beta\gamma$-dimethylglutaconic acids, prepared by methods which leave no doubt as to their constitution, are not isomeric but identical. α-Methyl-β-ethylglutaconic acid and β-methyl-γ-ethylglutaconic acid are also identical.

Derivatives of glutaconic acid are produced when ethyl cyanoacetate or its monoalkyl derivatives react with ethyl acetoacetate or its monoalkyl derivatives, the ethyl salts formed yielding either (1) derivatives of glutaconic acid or (2) derivatives of 2 : 6-dioxypyridine, according to the nature of the hydrolysing agent and the constitution of the salt.

*181. "Some alkyl derivatives of glutaconic acid and of 2 : 6-dioxypyridine." By Harold Rogerson and Jocelyn Field Thorpe.

Methods for the preparation of all the methyl derivatives of glutaconic acid are described, as well as the modes of preparation and properties of the corresponding derivatives of 2 : 6-dioxypyridine.

*182. "Note on the formation of β-methylglutaconic acid and of $\alpha\beta$-dimethylglutaconic acid." By Francis Vernon Darbishire and Jocelyn Field Thorpe.

By the elimination of hydrogen bromide from ethyl α-bromo-β-methylglutarate a mixture is obtained from which β-methylglutaconic acid can be isolated, the residue consisting of the lactone ethyl salt and the corresponding acid of the trimethylene ring.

From ethyl α-bromo-$\alpha\beta$-dimethylglutarate, similar products are formed, only in this case a much larger quantity of the glutaconic acid ($\alpha\beta$-dimethylglutaconic acid) can be obtained.

*183. "The influence of water and alcohols on the boiling point of esters. I. A modification of Markownikoff's method of preparation." By John Wade.

Ethyl acetate forms binary and ternary mixtures of minimum boiling point with ethyl alcohol and water. The ternary mixture, which contains 9 per cent. of alcohol and 8 per cent. of water, boils constantly at 70·3°, whilst the binary mixtures, which contain respectively 8·6 per cent. of water and 30·6 per cent. of alcohol, boil constantly at 70·5° and 71·8°. Most esters form such mixtures with their constituent alcohols and water, and in preparing esters from acids and alcohols by Markownikoff's method of continuous distillation in presence of sulphuric acid (*Ber.*, 1873, **6**, 1177), ternary mixtures are therefore usually obtained.

As the Markownikoff interaction, unlike the etherification process on which it is based, now proves on investigation to proceed in most cases readily at 100°, and in presence of any strong acid, it may be modified to afford a general and practically automatic method of preparing these ternary mixtures and their constituent esters in quantity. The lower alkyl esters of formic, acetic, propionic, and butyric acids have been made in this way under ordinary pressure, and various less volatile esters at the samo temperature under somewhat reduced pressure. Owing to the peculiar relation of the binary to the ternary mixtures the excess of alcohol may often be removed from these products by distillation with water and fractionation.

*184. "Note on bromine fluoride."
By Edmund Brydges Rudhall Prideaux.

Fluorine when passed over bromine combines with it, as stated by Moissan, who has described the appearance of the reaction ("Le Fluor et Ses Composés"). The product, which is more unstable than iodine fluoride and decomposes water with great violence, has not been described. It is a pale yellow liquid with a specific gravity less than that of bromine, and freezes to a white solid which melts at −2°. The analysis of this fluoride leads to the formula BrF_3, and this compound appears to be the only definite fluoride of bromine.

185. "Solution and pseudo-solution. Part IV." By Ernest Linder and Harold Picton.

The authors have completed, so far as they are able, the study of solution and pseudo-solution originated by them in 1892 (*Trans.*, **61**, 114—148). The results are arranged in three sections.

Section I. The Physical and Chemical Properties of Colloidal Arsenious Sulphide.—The precipitates, which separate when arsenious sulphide is coagulated by metallic salts, are regarded as metallic derivatives of a complex hydrosulphide formed by interchange of hydrogen for metal. Thus,

$$x\mathrm{As_2S_3,H_2S} + \mathrm{BaCl_2} = x\mathrm{As_2S_3,BaS} + 2\mathrm{HCl}.$$

The coagulation process for salts of uni-, bi-, and ter-valent metals is reviewed in the light of this hypothesis. Quadrivalent metals, such as platinum and zirconium, are found to be non-coagulants of arsenious sulphide in dilute solution.

The aggregation and de-aggregation phenomena of arsenious sulphide have been studied microscopically.

Section II. The Physical and Chemical Properties of Colloidal Ferric Hydroxide.—Various "grades" of colloidal ferric hydroxide have been prepared by dialysis. The physical and chemical properties of certain of these solutions and the coagulation phenomena of the colloidal hydroxychloride have been studied by methods similar to those applied in the investigation on arsenious sulphide.

Section III. Dyeing, a Phase of Coagulation.—The "substantive dyeing" of colloidal ferric hydroxide and arsenious sulphide by methyl-violet and aniline-blue is shown to exhibit phenomena which are precisely analogous to those occurring when these colloids are coagulated by metallic salts.

186. "The influence of very strong electromagnetic fields on the spark spectra of ruthenium, rhodium, and palladium." By John Edward Purvis.

The experiments were made with a 21-foot concave grating spectroscope. The spark passed between electrodes of the metals which were firmly held between the poles of a magnet. The strength of the field between the poles of the magnet was 40,000 units with a current of 21 amperes. The nature of the vibrations was analysed by a calcite prism. The general results showed that (1) most of the lines are divided into triplets, and that there is a periodic or rhythmic change in the directions of the vibrations of the constituents of the triplets. (2) Some lines become quadruplets, and within certain definite regions of the spectrum their constituents also change the directions of their vibrations. (3) Other lines become doublets. (Only a very few lines are not affected when vibrating in the magnetic field.) (4) The inner member of the triplets is usually the strongest; but this is not always the case. The two outer members of a triplet may be stronger than the inner one; and all three are sometimes equally strong.

(5) The strongest spectral lines are not the most widely separated when vibrating in the field. Weak lines are usually more widely separated than strong ones. (6) The decrease in the width of the triplets does not proceed *pari passu* from the less refrangible to the more refrangible end of the spectrum.

187. "A volumetric method of estimating the cinchona alkaloids by means of their double thiocyanates." By Philip Wilfred Robertson.

Skey has pointed out that many alkaloids give precipitates with ammonium thiocyanate in the presence of a zinc or mercury salt. Many other metals act in a similar manner; zinc, however, forms the most insoluble precipitates. The alkaloids most sensitive to this reaction are quinine and the cinchona alkaloids. Thus in the presence of excess of zinc sulphate and ammonium thiocyanate, one part of quinine gives a distinct turbidity in 50,000 parts of water.

These precipitates prove to be double salts of considerable complexity, as is the case with the compounds of many alkaloids, more especially quinine and its allies.

Thus cinchonine ammonium zinc thiocyanate has the following composition: $4C_{19}H_{22}ON_2,3Zn(CNS)_2,2NH_4CNS,4HCNS$.

This formula corresponds closely with that of herapathite or iodoquinine sulphate, $4C_{20}H_{24}O_2N_2,3H_2SO_4,2HI,4I_2,3Aq$.

Notwithstanding the complexity of these double salts, the determination of the amount of thiocyanate removed from solution by the alkaloids forms an accurate and speedy volumetric method of estimating quinine in the commercial drugs and in the assay of the crude cinchona bark.

188. "The osmotic pressure of sugar solutions in mixtures of alcohol and water." By Percival Smith Barlow.

Some experiments have been made with copper ferrocyanide membranes and solutions of sugar in a mixed solvent of alcohol and water, which confirmed Tammann's observation that an osmotic current cannot be obtained with these membranes and alcohol. The author's experiments were spread over a considerable time, in some cases months being allowed to elapse, so that every opportunity might be afforded for the pressure to show itself. For membranes permeable to water only, the van't Hoff value of the osmotic pressure is very much diminished by the presence of the alcohol, but no idea has been obtained as yet of any relation between the amounts of alcohol present and the amount of the reduction in the pressures; below a certain strength of sugar solution there is no direct evidence of osmotic pressure, the alcohol present quite overshadowing the effect of the sugar. There are indications that the membrane is rendered permeable to the sugar by the presence of alcohol. For a membrane permeable to the alcohol only, the pressure set up is very much less than above, and is produced extremely slowly. Whatever molecular aggregates are formed in connection with the sugar, it seems that the alcohol molecules take much less part in them than the water molecules.

ADDITIONS TO THE LIBRARY

I. *Donations.*

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From the Publishers.

Berthelot, Marcellin Pierre Eugène. Traité pratique de calorimétrie chimique. Deuxième édition. · pp. xiii + 317. ill. Paris 1905. (*Recd.* 14/8/05.) From the Author.

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Traité de chimie minérale. Publié sous la direction de Henri Moissan. Tome II, Fasc. 2. Tome IV, Fasc. 2. pp. 258, 471. Paris 1905. (*Reference.*) From Professor H. Moissan.

United States. Changes in the Pharmacopœia of the United States of America. Eighth decennial revision. By Reid Hunt and Murray Galt Motter. pp. 122. Washington 1905. (*Recd.* 4/10/05.)
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II. *By Purchase.*

Landolt, Hans Heinrich, Börnstein, Richard, und Meyerhoffer, Wilhelm. Physikalisch-chemische Tabellen. Dritte Auflage. pp. xvi + 861. Berlin 1905. (*Reference.*)

Baly, E. C. C. Spectroscopy. ill. pp. xi + 568. London 1905. (*Recd.* 11/7/05.)

III. *Pamphlets.*

Becker, George F., and Day, Arthur L. An interesting pseudo-solid. (From the *Proc. Washington Acad. of Sci.*, 7, 1905.)

—— The linear force of growing crystals. (From the *Proc. Washington Acad. of Sci.*, 7, 1905.)

Clarke, F. W. On basic substitutions in the zeolites. (From the *Proc. Washington Acad. of Sci.*, 7, 1905.)

Corlette, Cyril E. A review of the subject of starch digestion in young infants. (From the *Australasian Medical Gazette*, 24, 1905.)

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Gebhardt, A. Über den Dampfdruck von Quecksilber und Natrium. (From the *Verhandl. d. Phys. Ges.*, 7, 1905.)

Gray, George. On the retrogression of soluble phosphates in mixed manures. (From the *Trans. Australasian Assoc. Adv. Sci.*, 1904.)

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Hirt, W. B., and Steel, F. W. A rapid volumetric method for the determination of phosphoric acid. (From the *Proc. Soc. Chem. Ind. Victoria*, May, 1905.)

Matthies, W. Über Potentialmessungen im Joddampf. (From the *Sitzungsber. physikal.-medizin. Soz. Erlangen*, 37, 1905.)

Reade, T. Mellard, and Holland, Philip. Sands and sediments. (From the *Proc. Liverpool Geol. Soc.*, 1903—1905.)

Thwaite, B. H. Accidents due to asphyxiation of blast-furnace workmen. (From the *J. Iron and Steel Inst.*, 1905.)

Wiedemann, E. Über Dampfdrucke, besonders solche von festen

Körpern, nach Untersuchungen von K. Stelzner und G. Niederschulte. (From the *Verhandl. d. Phys. Ges.*, **7**, 1905.)

Yorkshire Geological and Polytechnic Society. The underground waters of North-West Yorkshire. Part II. The underground waters of Ingleborough. (From the *Proc. Yorks. Geol. and Polytech. Soc.*, **15**, 1904.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 11th, 1905.

At the next Ordinary Meeting, on **Thursday**, November **16**th, 1905, at **8.30** p.m., the following papers will be communicated:

"Silicon researches. Part IX. Bromination of silicophenyl imide and amide, and formation of a compound including the group (SiN)." By J. E. Reynolds.

"Condensation of ketones with mercury cyanide." By J. E. Marsh and R. de J. F. Struthers.

"Application of the microscopic method of molecular weight determination to solvents of high boiling point." By G. Barger and A. J. Ewins.

"Green compounds of cobalt produced by oxidising agents." By R. G. Durrant.

"Synthesis of tertiary menthol and of inactive menthene." By W. H. Perkin, jun.

"Optically active reduced naphthoic acids. Part I. Dextro-$\Delta^{(2 \text{ or } 3)}$-dihydro-1-naphthoic acid." By R. H. Pickard and A. Neville.

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Issued 24/11/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 300.

Thursday, November 16th, 1905, at 8.30 p.m. Professor R. Meldola, F.R.S., President, in the Chair.

Dr. Julien Drugman was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

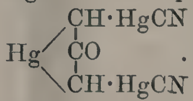
William Edward Bell, 88, Monks Road, Lincoln.
Thomas Harold Durrans, 1, Cornwall Terrace, Regent's Park, N.W.
Walter Hamis Glover, Ph.D., 38, Ribblesdale Road, Streatham, S.W.
William Prince Hayworth, 119, Clapton Common, London, N.E.
John Kirby Shrimpton, 22, Fountains Terrace, North Road, Ripon.
Franklin Wilfred Walker, 39, Graham Road, Acton Green, W.
Richard Alfred Warren, Belle Vue, Hallow Road, Worcester.
Harold Joseph Wheaton, 21, Chesterton Road, Cambridge.
Herbert William Mills Willett, The Cedars, Chislehurst.
Ernest Edwin Wolfe, Kinsale, Co. Cork, Ireland.

Certificates were authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of Messrs.:

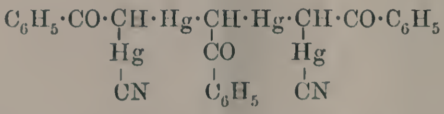
Charles Anthony, jun., Town Hall, East London, Cape Colony.
John Dunlop Millen, Launceston, Tasmania.
Henry Rowley, Perth, Western Australia.

Of the following papers, those marked * were read :

*189. "Condensation of ketones with mercury cyanide." By James Ernest Marsh and Robert de Jersey Fleming-Struthers.

Acetone added to a solution of mercury cyanide in aqueous caustic soda gives a white precipitate, $Hg_3C_5H_2ON_2$, insoluble in water or alcohol, which dissolves on further addition of acetone. The best yield is obtained with one molecule of acetone to not less than fifteen molecules of mercury cyanide. No precipitate at all is formed with one molecule of acetone to less than two molecules of mercury cyanide. The reaction forms a good test for acetone applicable also in presence of alcohol. The following formula represents the probable constitution of the compound :  . The same substance is formed by adding acetone to a solution of mercury cyanide and sodium ethoxide in alcohol, or sodium methoxide in methyl alcohol. The compound, which is decomposed by hydrochloric acid with liberation of acetone and hydrogen cyanide, is also decomposed by aqueous potassium cyanide with liberation of acetone. Strong sulphuric acid attacks it slowly, forming a soluble compound which is being further investigated.

Acetophenone yields a similar compound, $Hg_4C_{26}H_{18}O_3N_2$, with mercury cyanide in aqueous caustic soda ; the constitution of this product may probably be represented by the following formula :



$$C_6H_5\cdot CO\cdot \underset{\substack{|\\ Hg\\ |\\ CN}}{CH}\cdot Hg\cdot \underset{\substack{|\\ CO\\ |\\ C_6H_5}}{CH}\cdot Hg\cdot \underset{\substack{|\\ Hg\\ |\\ CN}}{CH}\cdot CO\cdot C_6H_5 .$$

The reactions appear to be confined to ketones containing the group $CO\cdot CH_3$; precipitates were not obtained with diethyl ketone, benzophenone, menthone, or camphor. But ethyl acetoacetate and diphenylmethyl ketone give similar compounds. Precipitates were also obtained with ethyl malonate and ethyl *iso*succinate. Aldehydes generally bring about a reduction of the mercury cyanide. Benzaldehyde and anisaldehyde give almost quantitatively their respective acids.

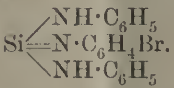
*190. "Silicon researches. Part IX. Bromination of silicophenylimide and -amide, and formation of a compound including the group (SiN)." By James Emerson Reynolds.

In Part VII of this series of papers, the author showed that the fine crystalline silicophenylamide, $Si(NHC_6H_5)_4$, described in Part V, can be made to afford silicotriphenylguanidine, and, ultimately, silicodiphenylimide, $Si(NC_6H_5)_2$. The latter is isomeric with the still unknown silicocyanamide, $SiN{\cdot}N(C_6H_5)_2$. The aim of the present inquiry has been to study the action of bromine directly on the di-imide, or indirectly through the silicophenylamide, in the hope of forming a compound including the group SiN analogous to cyanogen.

The di-imide in the form of very fine powder was found to combine with two atomic proportions of bromine, even in the cold, when the halogen was present in benzene solution, the insoluble additive compound, $Si(NC_6H_5)_2Br_2$, being formed. When this substance was warmed with excess of bromine, also diluted with much benzene, the aniline residues were attacked and variable mixtures were obtained, which proved to be very difficult to separate. On the other hand, silicophenylamide, being easily soluble in benzene, was found to be much more suitable for the systematic study of the products of bromination.

One molecular proportion of silicotetraphenylamide in benzene solution interacts quite regularly with about six atomic proportions of bromine, also dissolved in benzene, provided the temperature is kept down and the addition of the halogen made very slowly. The colour of bromine disappears and a precipitate forms from the outset consisting of aniline and bromoaniline hydrobromides. It was found, however, that three successive stages can be recognised in this interaction, and each one has been closely examined.

(1) In the first stage, bromine (2 atoms) effects the removal of one of the aniline residues in the form of hydrobromide, which separates out, and there remains in solution the substituted guanidine,

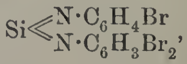
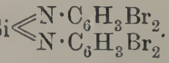


$$Si\begin{cases} NH{\cdot}C_6H_5 \\ N{\cdot}C_6H_4Br. \\ NH{\cdot}C_6H_5 \end{cases}$$

(2) At the second stage, the guanidine is attacked by a similar proportion of bromine, which causes the removal of more hydrobromide and the formation of a soluble disubstituted di-imide, $Si\begin{matrix} \diagup N{\cdot}C_6H_4Br \\ \diagdown N{\cdot}C_6H_4Br \end{matrix}$. This substance does not appear to form another additive compound analogous to that afforded by the unsubstituted di-imide.

(3) The third stage, in which another molecule of bromine acts on the substituted di-imide, is to some extent conditioned by the dilution

of the benzene solution in which the interaction takes place; but the chief change involves the removal of a third aniline residue, leaving in solution the SiN compound $\mathrm{SiN{\cdot}C_6H_3Br_2}$.

Under varying conditions, more or less of at least one other substance is formed, with the elimination of HBr, namely,  $\mathrm{Si}\lessdot^{\mathrm{N{\cdot}C_6H_4Br}}_{\mathrm{N{\cdot}C_6H_3Br_2}}$, and, probably, a still smaller proportion of  $\mathrm{Si}\lessdot^{\mathrm{N{\cdot}C_6H_3Br_2}}_{\mathrm{N{\cdot}C_6H_3Br_2}}$.

The nitrile, when purified as far as is at present possible, is a dark-coloured, vitreous solid fusible at about 60°. It is easily decomposed by water and alcohol, but is dissolved as a whole by pure ether, provided the temperature is not allowed to rise above 5°. At the ordinary temperature, the solution decomposes and ethyl silicates are formed, whilst a brown precipitate slowly separates, chiefly consisting of a bromoaniline derivative.

Treatment with excess of bromine leads to the production of silicon bromide and hydrogen bromide, whilst highly brominated anilines separate.

*191. "Application of the microscopic method of molecular weight determination to solvents of high boiling point."

By George Barger and Arthur James Ewins.

The method by which the vapour pressures of two solutions are compared, by measuring microscopically the change in thickness which drops of these solutions undergo when placed in a capillary tube, was originally worked out by one of the authors for use at the laboratory temperature (*Trans.*, 1904, 85, 286). A hot stage is now described, which can readily be made, and by means of which the tubes can be kept under observation at a constant temperature (up to 95°). The capillaries are fastened to a microscope slide, which is fixed with a spring inside a glass tube, about 25 millimetres wide, through which a stream of hot water flows, thus keeping the temperature constant to within one or two degrees. This tube is provided with a thermometer and rests in a block of wood on the microscope stage.

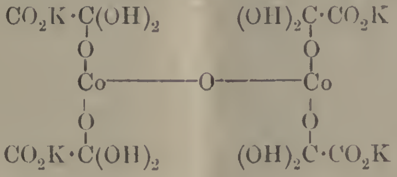
With volatile solvents, such as alcohol and benzene, one per cent. differences in the molecular concentration of two solutions can be detected in five to ten minutes at a temperature of about 80°. With aniline, the least volatile solvent which can be conveniently employed, the corresponding time at 95° is one hour.

The solvent need not be pure: oil of turpentine, for example, gave satisfactory results. The time required for a complete determination is about an hour and a half; for the mere verification of a probable formula, much less time is necessary. The average error in thirty determinations quoted is three per cent. Pyridine, acetic acid, and aniline are the best of the less volatile solvents examined.

*192. "Green compounds of cobalt produced by oxidising agents." By Reginald Graham Durrant.

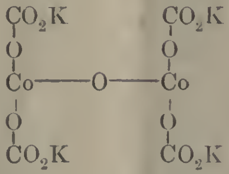
Methods of obtaining green compounds by oxidising cobaltous salts in presence of the alkali salts of acetic, tartaric, citric, oxalic, lactic, malic, succinic, and glycollic acids were given. The preparation, analysis and properties of green crystalline potassium cobaltic oxalate were set forth in detail, and evidence was adduced in support of the existence of analogous crystalline ammonium cobaltic and calcium cobaltic oxalates.

The conclusions arrived at are that (1) these substances most probably all contain the nucleus $>Co\cdot O\cdot Co<$, the oxalate being



$$\begin{array}{ccc} CO_2K\cdot C(OH)_2 & & (OH)_2C\cdot CO_2K \\ | & & | \\ O & & O \\ | & & | \\ Co & \text{———}O\text{———} & Co \\ | & & | \\ O & & O \\ | & & | \\ CO_2K\cdot C(OH)_2 & & (OH)_2C\cdot CO_2K \end{array},$$

and the carbonate



$$\begin{array}{ccc} CO_2K & & CO_2K \\ | & & | \\ O & & O \\ | & & | \\ Co & \text{——}O\text{——} & Co \\ | & & | \\ O & & O \\ | & & | \\ CO_2K & & CO_2K \end{array}.$$

(2) The prevailing green colour in these cobaltic compounds with carboxylic salts depends on the persistence of the complex $Co\cdot O\cdot Co$.

(3) The differences observable in the tints and in the absorption spectra of the various green solutions depend probably on the varied association of carboxyl groups attached to this nucleus.

*193. "Dunstan, Jowett, and Goulding's paper on the rusting of iron." By Edward Divers.

The fact which throws into the background all others contained in the important paper by Dunstan, Jowett, and Goulding on the rusting of iron (*Trans.*, 1905, **87**, 1548), and, indeed, constitutes its substance, is that even the purest available iron is freely rusted by oxygen and liquid water, unaided by carbon dioxide or any other substance. Yet, in the construction of the paper, this fact seems to have been subordinated, perhaps without intention, to the setting forth of, and submitting evidence for, the theory that the rusting of iron is a process involving the formation of hydrogen peroxide. Accordingly, the publication (*Proc.*, 1903, **19**, 150) of a preliminary abstract of the contents of the full paper led Moody (*loc. cit.*, p. 157) to suppose Dunstan's contention to be that ordinary rusting is caused by hydrogen peroxide. There is, therefore, reason to fear that those chemists who may hesitate to accept the hydrogen peroxide theory will be apt to overlook the fact that whether with or without the intervention of hydrogen peroxide, iron rusts when in contact with nothing more than an aqueous solution of oxygen.

Now the truth of the authors' theory to explain the fact may well be doubted, although they themselves hold that they have obtained a considerable body of experimental evidence in favour of the temporary formation of hydrogen peroxide. For, in support of the theory, no other fact is to be found in the paper than that the alkalis and other substances, which interfere with the existence of hydrogen peroxide, likewise prevent the rusting of iron. But the coincidence here observed is fully and accurately accounted for, without dependence on hydrogen peroxide, as being the result of the inability of oxygen and water in presence of one of these substances to act together as *hydroxyl*, whether it be to form hydrogen peroxide, $(HO)_2$, or such a compound as zinc hydroxide, $Zn(HO)_2$. Hydrogen peroxide is not wanted in order to explain the rusting of iron; indeed, its production stands rather in the way of a simple theory. What is wanted is the presentation of free or at least available hydroxyl groups to unite with the iron. Again, it is hardly a tenable argument that a substance, because it interferes with the existence of another substance, must likewise prevent its formation. For instance, ferrous sulphate ends the existence of free chlorine, but it does not prevent manganese dioxide and hydrochloric acid in contact with it producing the atomic chlorine, which it immediately proceeds to consume.

Moritz Traube explained and experimentally illustrated what he called the "autoxidation" of metals and other substances as being the chemical intervention of the water molecule between that of the autoxidising substance and that of the oxygen. Water, which cannot be acted on by either alone, is capable of chemical partition between the two: with zinc present to seize the hydroxyl of the water, the oxygen can take the rest of its hydrogen to form hydrogen peroxide, and, accordingly, this substance is not an uncommon product of autoxidation. It is easy and natural to admit that, with the great evolution of energy in the union of zinc with hydroxyl, only the small addition of energy afforded by the hydrogenation of free oxygen into hydrogen peroxide should be sufficient to half dehydrogenate the oxygen of water. Traube's equation satisfactorily represents, therefore, the formation of the hydrogen peroxide. The authors, however, give equations which are indistinguishable from those suggested by Hoppe-Seyler, although they very rightly reject this physiological chemist's conception of the nature of oxidation. They write (*loc. cit.*, p. 1549) $Fe + O_2 + H_2O = FeO + H_2O_2$ [Traube would have written it $Fe + 2OH\cdot H + O_2 = Fe(OH)_2 + H_2O_2$]. Again, on p. 1564, they write $Fe + OH_2 = FeO + H_2$; $H_2 + O_2 = H_2O_2$, equations which have none of the acceptability of Traube's. Can it be admitted that iron may do what potassium cannot do, displace all the hydrogen of water? Can it be allowed by the laws of thermal chemistry that cold water can be endothermically oxidised into hydrogen peroxide? There is another equation, given to explain the action of hydrogen peroxide on iron, to which also exception must be taken: $Fe + H_2O_2 = FeO + H_2O$. Surely if the equation holds good at all, the right side of it should be written $Fe(OH)_2$, the hydroxyls uniting with the iron, even if, afterwards, water separates.

The conversion of iron into rust seems to be as fully explained and as simply displayed as the facts allow by the following equation: $(O_2 + 2H\cdot HO) + 4Fe + 2O_2 = 4HO\cdot Fe\vdots O$, or, if preferred, $2(HO)_2Fe_2O_2$. If it is proper, as it apparently may be, to represent the ferrous and the ferric oxidation as distinct, then the above equation may be resolved into $(O_2 + 2H\cdot HO) + 4Fe + O_2 = 2(HO\cdot Fe'')_2O$ (ferrous oxyhydroxide) and $2(HOFe'')_2O + O_2 = 4HO\cdot Fe'''O$. Putting these equations into words, rusting consists in the oxidation of iron by oxygen, with the intervention of water as hydroxyl hydride to the extent of two * molecules for every three molecules of oxygen consumed. To account for the non-formation of hydrogen peroxide nothing need be advanced; that seems to come as a matter of course. The point to be explained is, rather, the very production of this substance during the autoxidation of zinc and other substances. Why do not all the hydroxyls combine with the zinc, instead of a very small proportion of them remaining as hydrogen peroxide? The equation $Zn + 2OH\cdot H + O_2 + Zn = 2Zn(OH)_2$ seems to express accurately what really does happen to a very great extent.

DISCUSSION.

The following communication from Professor DUNSTAN was read by the Secretary: "In the preceding note, Dr. Divers has expressed the fear that the important fact established in the paper by Drs. Jowett and Goulding, and myself, that iron will rust in an aqueous solution

* Instead of the six molecules of water required by Traube's equation in the theoretical production of $Fe_2(OH)_6$.

of oxygen without carbon dioxide, will be overlooked. This fear is, however, not justified in view of the explicit statements contained in the paper and the prominence given to the experimental evidence.

"Dr. Divers is of opinion that the intermediate formation of hydrogen peroxide, suggested as a working hypothesis to account for the observed facts, is unnecessary, but the alternative view expressed by him as 'the presentation of available or free hydroxyl groups to unite with iron' is not intelligible, unless it amounts to what is virtually the same hypothesis, which accounts for the inhibiting effect of potassium dichromate as well as of alkalis.

"With regard to the mechanism of the change, it has not been suggested, as Dr. Divers supposes, that water is oxidised to hydrogen peroxide. On the contrary, Traube's view of the formation of hydrogen peroxide is accepted. The outline equations in the paper (*Trans.*, 1905, 87, 1548) were not intended to do more than represent the general nature of the change, and may equally well be written to show that the metal takes the hydroxyl and not strictly the oxygen of the water. There is no exception to be taken to the condensed equations Dr. Divers gives in conclusion, but unless the intermediate formation of hydrogen peroxide is assumed, they do not explain the inhibiting effect of alkalis or of other salts. There is no evidence to show that alkalis interfere with the formation of simple hydroxides such as $Zn(OH)_2$.

"Dr. Divers fails to offer any satisfactory explanation of the undoubted formation of hydrogen peroxide during the 'rusting' of zinc, where the process at work must be strictly analogous to that which occurs in the case of iron."

Mr. A. C. CHAPMAN said that it was rather surprising that investigators who had studied the rusting of iron and the action of water on other metals in the presence of oxygen should have apparently devoted so little attention to the influence of traces of metallic impurities in the metals under observation. Such changes were, of course, electrolytic in nature, and it seemed to him very probable that in many cases the action would be very greatly modified if metals of a very high degree of purity could be used in the experiments. Dr. Divers had referred to the combined action of oxygen and water on metallic zinc, and he had recently had occasion to observe how very greatly this was affected by the presence of very slight traces of nickel, cobalt, or other metallic impurities in the zinc employed.

In reply, Dr. DIVERS referred Professor Dunstan and also Dr. Jowett to his foregoing note, in which it is explained that the inhibitory action of such a substance as potassium hydroxide or dichromate is fully accounted for as being due to its making oxygen and water unable to behave either as hydroxyl towards iron or as hydroxyl for becoming hydrogen peroxide. He thought with Mr. Chapman that even the purest zinc yet used may have been active upon air and water through electrolysis by means of some impurity.

He was aware that the authors had treated iron as being acted on by hydrogen peroxide, but all that he had wished to contend against had been their assumption that air and water owe their activity to a production of hydrogen peroxide. Dr. Moody had fully shown that hydrogen peroxide in pure water is inactive upon iron.

*194. "Researches on the freezing points of binary mixtures of organic substances: the behaviour of the dihydric phenols towards *p*-toluidine, α-naphthylamine, and picric acid." By James Charles Philip and Sydney Herbert Smith.

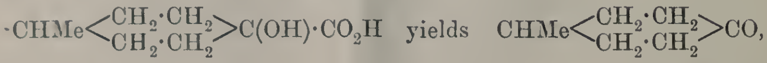
Investigation of the freezing-point curves demonstrates the existence of several new compounds of the above substances. As might have been expected, it was found that catechol and resorcinol were able in certain cases to form two compounds with a base: for example, catechol forms two compounds with *p*-toluidine containing the constituents in the molecular ratio of 1 : 1 and 1 : 2 respectively, and freezing at 50·4° and 41·5°. Since the 50 molecular per cent. compound crystallises sluggishly, it is possible to realise metastable freezing points on the adjacent branches of the curve. In this respect, the 50 per cent. compound is similar to $Fe_2Cl_6,7H_2O$ in Roozeboom's curve for the hydrates of Fe_2Cl_6. Resorcinol and *p*-toluidine were also found to combine in two proportions.

Quinol does not form compounds so readily as resorcinol and catechol, and in the case of quinol and α-naphthylamine only a slight indication of the formation of a compound is obtained in the form of an intermediate branch of the curve which does not reach a summit.

The picrates of catechol and resorcinol, as shown by the freezing-point curves, are well-defined compounds containing a molecule of each constituent. The freezing point of catechol picrate is higher than the freezing point of either component.

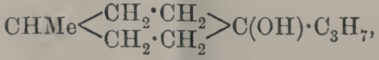
195. "Synthesis of tertiary menthol and of inactive menthene." By William Henry Perkin, jun.

When hexahydro-*p*-toluic acid is treated with phosphorus pentachloride and bromine, it is converted into α-bromohexahydro-*p*-toluic acid (Perkin and Pickles, *Trans.*, 1905, 87, 645), which melts at 109—110° and is hydrolysed by dilute sodium carbonate with formation of α-hydroxyhexahydro-*p*-toluic acid (m. p. 132°) and Δ^1-tetrahydro-*p*-toluic acid. The hydroxy-acid is readily decomposed by sulphuric acid with elimination of carbon monoxide, and the solution, on dilution with water, yields 1 : 4-methyl*cyclo*hexanone (b. p. 170°) :

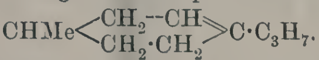


$$\cdot\mathrm{CHMe}\!<\!\begin{matrix}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\!>\!\mathrm{C(OH)\cdot CO_2H}\quad\text{yields}\quad \mathrm{CHMe}\!<\!\begin{matrix}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\!>\!\mathrm{CO},$$

considerable quantities of Δ^1-tetrahydro-*p*-toluic acid being produced at the same time. 1 : 4-Methyl*cyclo*hexanone reacts readily with magnesium *iso*propyl iodide and is converted into *tertiary menthol*,

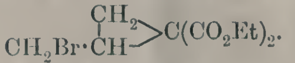


$$\mathrm{CHMe}\!<\!\begin{matrix}\mathrm{CH_2\cdot CH_2}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\!>\!\mathrm{C(OH)\cdot C_3H_7},$$

which distils at 95° under 25 mm. pressure (compare Baeyer, *Ber.*, 1893, **26**, 2270), and when digested with potassium hydrogen sulphate yields *inactive menthene*,  $\mathrm{CHMe}\!<\!\begin{matrix}\mathrm{CH_2-CH}\\ \mathrm{CH_2\cdot CH_2}\end{matrix}\!\geqslant\!\mathrm{C\cdot C_3H_7}$.

This synthetical hydrocarbon distilled at 168° and yielded the characteristic *nitrosochloride* melting at 128° ; there can therefore be no doubt that it is the inactive modification of menthene (compare Urban and Kremers, *Amer. Chem. J.*, 1894, **16**, 395).

196. "The synthetical formation of bridged rings. Part II. Some derivatives of di*cyclo*butane." By William Henry Perkin, jun., and John Lionel Simonsen.

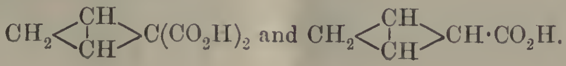
When the sodium derivative of ethyl malonate (1 mol.) is digested with tribromopropane, $\mathrm{CH_2Br\cdot CHBr\cdot CH_2Br}$, an ester of the formula $\mathrm{C_{10}H_{15}O_4Br}$ is obtained, which distils at 154° (26 mm.) and evidently has the constitution  $\begin{matrix}\mathrm{CH_2}\\ |\\ \mathrm{CH_2Br\cdot CH}\end{matrix}\!>\!\mathrm{C(CO_2Et)_2}$. Alcoholic potash decomposes this ester with formation of a crystalline acid, $\mathrm{C_4H_4(CO_2H)_2}$, which melts at 139°, is only slowly oxidised by permanganate, and does not decolorise a solution of bromine in chloroform ; it is not reduced when its solution in sodium carbonate is boiled with a large excess of sodium amalgam, and, when treated with hydrobromic acid, it is converted into a hydroxy-acid, $\mathrm{C_4H_5(OH)(CO_2H)_2}$, which melts at 150°.

It is readily esterified by alcohol and sulphuric acid, yielding an ester, $\mathrm{C_4H_4(CO_2Et)_2}$, which distils at 129° (22 mm.).

When the acid $\mathrm{C_4H_4(CO_2H)_2}$ is heated, it loses carbon dioxide with formation of the corresponding monobasic acid, $\mathrm{C_4H_5\cdot CO_2H}$, which melts at 57° and yields an ester, $\mathrm{C_4H_5\cdot CO_2Et}$, which distils at 160—161° (765 mm.).

The monobasic acid is not reduced when its alkaline solution is boiled with excess of sodium amalgam ; it does not decolorise bromine, and when treated with hydrobromic acid or hydriodic acid it yields a *dihydrobromide*, $C_4H_7Br_2\cdot CO_2H$ (m. p. 53°), and a *dihydriodide*, $C_4H_7I_2\cdot CO_2H$ (m. p. 90°), respectively.

These and other properties seem to prove that the acids $C_4H_4(CO_2H)_2$ and $C_4H_5\cdot CO_2H$ are *dicyclobutane* derivatives, having respectively the formulæ



$$CH_2{<}\begin{array}{c}CH\\ |\\ CH\end{array}{>}C(CO_2H)_2 \text{ and } CH_2{<}\begin{array}{c}CH\\ |\\ CH\end{array}{>}CH\cdot CO_2H.$$

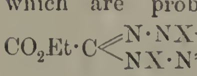
197. "Optically active reduced naphthoic acids. Part I. Dextro-$\Delta^{2\,(or\ 3)}$-dihydro-1-naphthoic acid." By Robert Howson Pickard and Allen Neville.

dextro-$\Delta^{2(or\ 3)}$-*Dihydro*-1-*naphthoic acid* is obtained from the *l*-menthylamine salt, which is less soluble in ethyl acetate than the corresponding salt of the lævo-acid; it has $[M]_D$ +370·4° in chloroform. The transformation of the $\Delta^{2(or\ 3)}$-acid into the Δ^1-acid in the presence of sodium hydroxide proceeds as a unimolecular reaction.

198. "Hydrizino-halides derived from oxalic acid." By Douglas Anderson Bowack and Arthur Lapworth.

All the azo-derivatives of ethyl acetoacetate which have been examined by the authors are converted, on treatment with bromine or chlorine, into hydrizino-halides * having the general formula $Cl[or\ Br]\cdot C(CO_2C_2H_5)\colon N\cdot NHX$ (compare *Trans.*, 1903, **83**, 1114).

The halogen atom in these compounds is very difficult to remove except in alkaline solution. With aqueous ammonia, the halogen is replaced by amidogen, whilst prolonged action of the agent leads to the further replacement of the ethoxyl group; the resulting compounds, $NH_2\cdot C(CO_2\cdot C_2H_5)\colon N\cdot NHX$ and $NH_2\cdot C(CO\cdot NH_2)\colon N\cdot NHX$, are yellow and feebly basic in character. The members of the former class may be converted into the corresponding carboxylic acids, which lose carbon dioxide when heated.

Solutions of the hydroxides or carbonates of the alkali metals act very rapidly on the hydrizino-halides, and condensation products which are probably dihydrotetrazine derivatives, for example,  $CO_2Et\cdot C{\leqslant}\begin{array}{c}N\cdot NX\\ NX\cdot N\end{array}{\geqslant}C\cdot CO_2Et$, are obtained. These compounds form deep red crystals with a blue reflex.

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* The term "hydrizino-" used for compounds containing the group $-NH\cdot N=$ corresponds with "imino," which refers to those including the radicle $-N$.

199. "The action of nitrogen sulphide on organic substances. Part III." By Oliver Charles Minty Davis.

The investigation of the action of nitrogen sulphide on the aldehydes has been continued, and it has been found that the reaction is not so general as was expected. Cinnamaldehyde, salicylaldehyde, and cuminaldehyde do not react to any extent, and the yields in other cases are very small. The nitrobenzaldehydes experimented with give the corresponding cyanidine derivatives, and an interesting example of steric hindrance is illustrated in the case of *o*-chlorobenzaldehyde, which is not appreciably decomposed, whereas the 1 : 4-compound readily yields the cyanidine derivative. A similar instance is noticed in the case of *o*-methoxybenzaldehyde, which furnishes a small amount of the cyanidine derivative, the 1 : 4-compound previously experimented with (*Trans.*, 1904, **85**, 1535) giving a good yield of the cyanidine, in addition to a sulphur compound and an anisamidine sulphate. Piperonaldehyde, on the other hand, in which the ortho-position with respect to the aldehyde grouping is unsubstituted, behaves in an analogous manner to anisaldehyde.

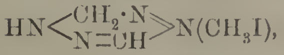
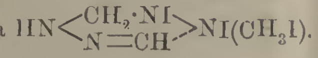
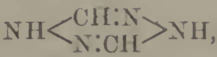
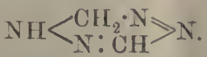
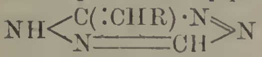
200. "The action of nitrogen sulphide on organic substances. Part IV." By Francis Ernest Francis.

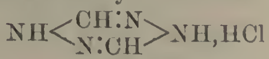
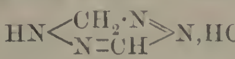
Nitrogen sulphide acts on acetic and propionic acids at their boiling points with the liberation of sulphur dioxide and smaller quantities of nitrogen and the formation of the corresponding amides and diamides; in both cases ammonium sulphate and free sulphur are also formed.

The action on acetic anhydride and the halogen derivatives of acetic acid is very similar. Chloro- and bromo-acetic acids give mixtures of their corresponding amides and diamides, di- and tri-chloroacetic acids only giving rise to di- and tri-chloroacetamides respectively.

That a deep-seated decomposition of the molecule takes place in these reactions is shown by the liberation of notable quantities of carbon monoxide, together with the other gases mentioned, and, further, the formation, in varying quantity, of the ammonium haloid salt corresponding with the halogen derivative employed.

201. "Tetrazoline. Part III." By Siegfried Ruhemann and Richard William Merriman.

The authors, who have undertaken this research with the view of investigating the remarkable properties of tetrazoline, and more especially of determining the constitutions of the two compounds which this base forms with methyl iodide (Ruhemann and Stapleton, *Trans.*, 1902, 81, 261), have found that the colourless substance $C_3H_7N_4I$ combines with iodine to yield the blue additive product identical with the compound which is produced along with $C_3H_7N_4I$ by the action of methyl iodide on tetrazoline. It therefore has the composition $C_3H_7N_4I_3$ instead of $C_3H_9N_4I_3$, as previously stated. The resemblance of this additive product to the periodide of diazobenzene chloride led the authors to the view that $C_3H_7N_4I$ has the constitution  $\mathrm{HN}<^{\mathrm{CH_2\cdot N}}_{\mathrm{N=CH}}>\mathrm{N(CH_3I)}$, and therefore $C_3H_7N_4I_3$ the analogous formula  $\mathrm{HN}<^{\mathrm{CH_2\cdot NI}}_{\mathrm{N=CH}}>\mathrm{NI(CH_3I)}$. It would therefore follow that the action of methyl iodide on tetrazoline,  $\mathrm{NH}<^{\mathrm{CH:N}}_{\mathrm{N:CH}}>\mathrm{NH}$, causes an isomerisation to  $\mathrm{NH}<^{\mathrm{CH_2\cdot N}}_{\mathrm{N:CH}}>\mathrm{N}$. Such a transformation, as shown, takes place readily by the action of aldehydes on tetrazoline in the presence of piperidine, when compounds of the general formula  $\mathrm{NH}<^{\mathrm{C(:CHR)\cdot N}}_{\mathrm{N=\!=\!=CH}}>\mathrm{N}$ are formed.

The authors have thus prepared a large number of condensation products, and have found that, although partially hydrolysed by hydrochloric acid, these solutions yield normal platinichlorides. The hydrolysis is complete on boiling with the dilute acid, and tetrazoline is formed together with aldehydes. The authors arrive at the conclusion that the hydrochloride of this base exists in two tautomeric forms,  $\mathrm{NH}<^{\mathrm{CH:N}}_{\mathrm{N:CH}}>\mathrm{NH,HCl}$ and  $\mathrm{HN}<^{\mathrm{CH_2\cdot N}}_{\mathrm{N=CH}}>\mathrm{N,HCl}$, which are interchangeable. Platinic chloride is used as a means of recognising them, since the one modification forms the canary-yellow additive product, $(C_2H_4N_4)_2,PtCl_4$, previously described, whilst the other yields the orange normal platinichloride, $(C_2H_4N_4)_2,H_2PtCl_6$.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

British Museum. Mineral Department. An introduction to the study of meteorites. With a list of the meteorites represented in the collection of January 1st, 1904. By L. Fletcher. pp. 109. London 1904. (*Recd.* 12/11/05.) From the Trustees.

Bronn, J. Verflüssigtes Ammoniak als Lösungsmittel. Materialien

über die chemischen Eigenschaften des verflüssigten Ammoniakgases. pp. 252. Berlin 1905. (*Recd.* 2/11/05.)
From Bennett H. Brough, Esq.

De l'Arbousset, Laurent. On silk and the silkworm. A practical treatise on sericulture. Translated by Elizabeth Wardle, and edited by her father, Sir Thomas Wardle. pp. viii + 287. ill. Leek 1905. (*Recd.* 12/8/05.) From Sir Thomas Wardle.

Foster, Sir Clement Le Neve. A treatise on ore and stone mining. Sixth edition, revised and enlarged by Bennett H. Brough. pp. xxx + 799. ill. London 1905. (*Recd.* 2/11/05.)
From Bennett H. Brough, Esq.

Hall, A. D. The book of the Rothamsted Experiments. pp. xl + 294. ill. London 1905. (*Recd.* 14/11/05.)
From the Author.

Handbuch der anorganischen Chemie. Herausgegeben von R. Abegg. Band II. Abteilung 2. pp. ix + 700. Leipzig 1905. (*Reference.*)
From the Publisher.

Institution of Mechanical Engineers. Sixth report to the Alloys Research Committee: on the heat treatment of steel. By the late Sir William C. Roberts-Austen, K.C.B., completed by Professor William Gowland. pp. 174. ill. London 1904. (*Recd.* 25/10/05.)
From Professor W. Gowland.

Morgan, J. Livingston Rutgers. The elements of physical chemistry. Third edition. pp. xii + 510. New York 1905. (*Recd.* 7/11/05.) From the Publishers.

Wade, John. Introduction to the study of organic chemistry. pp. xx + 646. ill. London 1905. (*Recd.* 16/11/05.)
From the Author.

Wells, Horace L. A text-book of chemical arithmetic. pp. 169. New York 1905. (*Recd.* 7/11/05.) From the Publishers.

II. *By Purchase.*

Jahn, Hans. Grundriss der Elektrochemie. Zweite Auflage. pp. xii + 549. Wien 1905. (*Recd.* 15/11/05.)

Senft, Emanuel. Mikroskopische Untersuchung des Wassers mit Bezug auf die in Abwässern und Schmutzwässern vorkommenden Mikroorganismen und Verunreinigungen. pp. viii + 196. ill. Wien 1905. (*Recd.* 15/11/05.)

RESEARCH FUND

A Meeting of the Research Fund Committee will be held in December next. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before Monday, December 11th, 1905.

At the next Ordinary Meeting, on **Thursday**, December **7th**, 1905, at **8.30** p.m., there will be a ballot for the election of Fellows and the following papers will be communicated :

"The constitution of nitrites. Part I. Two varieties of silver nitrite." By P. C. Rây and A. C. Gañguli.

"The products of heating silver nitrite." By E. Divers.

"Ethyl piperonylacetate." By W. H. Perkin, jun., and R. Robinson.

"A contribution to the chemistry of saccharin." By F. D. Chattaway.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 7th, 1905.

Adam, Adam Lawson Kelly,

296, Bath Street, Glasgow.

Analytical Chemist. I was for eight years Assistant in the Laboratory of Messrs. R. R. Tatlock & Thomson, Public Analysts, Glasgow, and for one year Teacher in the Students' Department of the same firm. I am now Research Chemist to Messrs. McCaw, Stevenson & Orr, Ltd., Linenhall Works, Belfast.

R. R. Tatlock. James McLeod.
R. T. Thomson. *J. Falconer King.*
Thomas Gray. *John Clark.*

Ahlum, C. Chester,

Lansdale, Pennsylvania, U.S.A.

Chemist for Geo. W. Lord Co., Phila., Chemist and Bacteriologist for Lansdale Board of Health. Member of the American Chemical Society and the Franklin Institute. Vice-pres. of the Lansdale Scientific Association. Have contributed papers to both the American Chemical Society and the Franklin Institute, and have given a number of lectures before the Lansdale Scientific Association.

(The papers are upon improved methods of analysis).

Ernest A. Congdon. Samuel C. Hooker.
Charles Platt. *J. Livingston R. Morgan.*
Clifford Richardson.

Alcock, James Edward,

42, Gill Street, Moston Lane, Blackley.

Chemist. Has been a student in the evening classes of the Chemical Department of the School of Technology, Manchester, for eight years, more especially in Chemical Technology. Engaged in Chemical Works for fourteen years, and for the last four years has held a responsible position. Wish to join the Society so as to be in closer touch with the subject and to obtain the Journal.

W. J. Pope. F. S. Sinnatt.
Jas. Grant. Stanley J. Peachey.
L. G. Radcliffe. *F. G. Richards.*

Allison, James Albert,

Luchana Laboratory, Apartado 45, Bilbao, Spain.

Analytical Chemist. Learnt Analytical Chemistry under Messrs. Pattinson and Stead, Middlesbro', and have had an experience of 24 years in the analysis of all kinds of minerals, &c. For 13 years as Chief Chemist at Darlington Steel Works, and afterwards at Bilbao, where all classes of minerals have to be constantly analysed.

Frank B. Last. H. Percy Lewis.
Jas. D. Dougall. *R. R. Tatlock.*
R. T. Thomson.

Barbrook, George Henry,

Stowmarket, Suffolk.

Analytical Chemist and Malting and Brewing Chemist for Thomas Prentice & Co., Stowmarket. I am desirous of keeping up with current literature.

John Heron. Otto Hehner.
Arthur R. Ling. *L. T. Thorne.*
Alfd. C. Chapman.

Barrowcliff, Marmaduke,

25, Priory Road, Kew, Surrey.

Research Chemist in the Wellcome Chemical Research Laboratories. Associate of the Institute of Chemistry. Five years' study of chemistry at Univ. Coll., Nottingham. Joint author of papers published in the Journal of the Chemical Society.

Frederick B. Power. R. M. Caven.
F. S. Kipping. H. A. D. Jowett.
A. C. O. Hann.

Brown, John Coggin,

Calcutta. (Home address) Fairleigh, Cockton Hill, Bishop Auckland.

Assistant Superintendent H.M. Geological Survey of India. Final B.Sc., Durham. Honours in Chemistry. Johnston Scholar in Chemistry and Mineralogy. Late Lecturer Assistant, Chemical Dept., Armstrong College, Newcastle-on-Tyne. Awarded Freire Marrew Medal and Prize for work on "Molybdenum." Saville Shaw Medal for work on "Uranium" by the Newcastle Sect. of the Soc. of Chem. Industry. Papers: "A Note on Molybdenum" (*Univ. Dur. Phil. Soc. Trans.*, June, 1905). "The Preparation of Some Compounds of Uranium from Pitchblende."

P. Phillips Bedson.	S. Hoare Collins.
F. C. Garrett.	Roger Dodds.

J. T. Dunn.

Burt, Bryce Chudleigh,

Port of Spain, Trinidad, B.W.I.

Assistant Analyst and Science Master to Government of Trinidad. Bachelor of Science, 1st Class Honours, Lond., 1901. University demonstrator and assistant lecturer, Liverpool, 1902–4. Published "The Solubilities of Lithium Nitrate and its Hydrates" (*Trans.*, 1903). "The Vapour Pressures of Sulphuric Acid" (*Proc.*, 1903, *Trans.*, 1904).

P. Carmody.	F. G. Donnan.
J. Campbell Brown.	A. W. Titherley.

W. Collingwood Williams.

Coates, Joseph Edward,

Sunnyside, Oakamoor, Stoke-on-Trent.

Scientific Chemist. B.Sc. (Wales), with First Class Honours in Chemistry. Osborn Morgan Student of University College, Bangor. Fellow of the University of Wales. Conjoint author of a paper on "Diazo-compounds" (*Proc. Chem. Soc.*, Vol. 21, No. 296).

Kennedy J. P. Orton.	James J. Dobbie.
Allan Baguley.	Alexander Lauder.

Robt. D. Abell.

Cowman, Douglas Henry Bellars,

Heathville Corner, Gloucester.

Chemistry Master, the Grammar School, Clonmel. Five years articled pupil and assistant to G. Embrey, F.C.S., F.I.C., Public

Analyst for Gloucester, &c. Assistant Chemist to Cotton Seed Co., Cubitt Town, E. Assistant chemist to United Asbestos Co.

George Embrey. J. M. Collett.
J. Holms Pollok. J. S. S. Brame.
C. R. Gardner.

Dallman, Arthur Augustine,
Lyndhurst, Prospect Vale, Liverpool.

Science Teacher. Student at Harris Institute, Preston, 1896—1901. Demonstrator and Assist. Lecturer in Chemistry, Liverpool College, 1901—1903. Lecturer in Chemistry, Port Sunlight Technical Institute, 1903. Demonstrator in Physical Chemistry and Physics, Liverpool College, 1903—1904. Science Master at Bebington College, Cheshire, from 1904.

Arthur J. Cooper. Lawrence Caldecott.
John B. Coppock. *Prosper H. Marsden.*
M. C. Clutterbuck.

Davey, Joseph Morgan,
Shelone House, Briton Ferry, Glam.

Analytical Chemist. Assistant Chemist to the Briton Ferry Works, Ltd., 1890—1894. Chief Chemist to the Albion Steel Co., Ltd., 1894—1901. Chief Chemist to the Briton Ferry Works, Ltd., 1901 to present time.

Herbert Eccles. *W. Gowland.*
Geo. R. Thompson. *Edwd. Riley.*
Pattinson B. Melmore *J. E. Stead.*

Davies, John Llewelyn,
8, Rugby Road, Neath.

Science Master. Natural Science Tripos, University of Cambridge, Part I, 1904, 1st Class, Chemistry one of the subjects; Part II, 1905, 2nd Class, Chemistry the only subject.

G. D. Liveing. H. O. Jones.
W. J. Sell. T. B. Wood.
H. J. H. Fenton.

Doull, John,
8, Lauriston Place, Edinburgh.

Brewer and Chemist (Archd. Campbell, Hope, and King, Ltd., Edinburgh). Studied Chemistry under J. Falconer King, Analyst for City of Edinburgh, &c. Also under John Hunter, Analyst for County of Midlothian, &c., and under Dr. Mackenzie, Heriot-Watt College. Medallist in Brewing, City and Guilds of London Institute. First

Class Honours Certificate in Brewing, City and Guilds of London Institute. Honorary Secretary of the Scottish Section, Institute of Brewing.

John S. Ford.
John M. Guthrie.
John Hunter.
Lawrence Briant.
J. Falconer King.

Dunlop, Harry,

Cragdarroch Cove, Dumbartonshire.

Analytical Chemist. For six years Student and Assistant to Messrs. R. R. Tatlock and Thomson, Public Analysts, Assayers, and Gas Examiners. Two years' experience in manufacture of Soap and Allied Products. Special work. Analysis and Investigations relating to Oils. Joint paper with Mr. R. T. Thomson on "Cod-liver Oil and other Fish Oils."

R. R. Tatlock.
J. Falconer King.
R. T. Thomson.
Thomas Gray.
James McLeod.
John Clark.

Gall, John Beaconsfield,

"Knoxland," Erith Road, Belvedere, Kent.

Chemist. Associate of the City and Guilds Institute. Fellow of the Institute of Chemistry.

Henry E. Armstrong.
Gerald T. Moody.
William A. Davis.
Bertram Blount.
Arthur G. Levy.

Haig, Sidney Montague,

St. Edmund's Avenue, Port Hill, Stoke-on-Trent.

Brewer. Student at Royal College of Science, London; Berlin Brewing Institute; Brewing School of Technology, Manchester; Chemist and Brewer at Parker's Brewery, Burslem, Staffs.

W. J. Pope.
Jas. Grant.
F. G. Richards.
F. S. Sinnatt.
Stanley J. Peachey.

Hart, Alfred,

Norman Avenue, Hawksburn, Victoria, Australia.

Analytical Chemist. M.A., B.Sc., Melbourne University, Victoria, Australia. First Class Honorman, Chemistry, Melbourne University. (Formerly) Science Master, Church of England Grammar School, Melbourne. (Now) Chemist to Messrs. Lewis and Whitty, Manufacturers, Flinder's Lane, Melbourne, Victoria, Australia.

Robert Law.
Orme Masson.
Fred. W. Steel.
D. Avery.
F. R. Power.
A. W. Craig.

Hayman, Jack Vernon Johnson,

Tringhurst, Cranleigh, Surrey.

Analytical Chemist to Cement Works. Three years' course in Chemical Department, Central Technical College, S. Kensington, gaining Diploma of Associate (A.C.G.I.); late Assistant Chemist to Messrs. Henry Faija and Co., Westminster; late Research Chemist Messrs. Harnett, Ltd., Stratford; now Chemist to Messrs. Robert Stephenson and Son, Ltd., Cement Manufacturers, Burwell, near Cambridge.

Henry E. Armstrong.	William Robertson.
Gerald T. Moody.	Robert J. Caldwell.
T. Martin Lowry.	Robert Stephenson.

Higgins, John Michael,

39, Queen Street, Melbourne.

Consulting Metallurgist. Member Pharmaceutical Society (Aust.), Major Examination. Certificated Student, Bendigo School of Mines, for Chemistry and Metallurgy.

G. C. McMurtry.	Edward H. Rennie.
T. J. Greenway.	L. R. Scammell.

G. A. Goyder.

Hill, William Basil,

Eastfield, Stockton Lane, York.

Tanner (of Hill Bros., Foss Islands Tannery, York). Student in the Leather Industries Laboratory in the Yorkshire College, Leeds, 1895—6. Member of the Society of Chemical Industry. Associate of the International Association of Leather Trades Chemists.

J. H. Ashwell.	Henry R. Procter.
Arthur Smithells.	Geo. Ward.
Thomas Fairley.	B. A. Burrell.

Oliver Quibell.

Hobsbaum, Isaac Berkwood,

79, Claremont Road, Forest Gate, London, E.

Analytical, Research, and Works Chemist. I am a holder of the Diploma of the School of Technology, Manchester, where I studied under Dr. E. Knecht and Prof. W. J. Pope, F.R.S., and for 2½ years have been engaged in Manufacturing Chemistry at Manchester, Sheffield, and now with A. Boake Roberts, of Stratford, London.

William J. Pope.	L. G. Radcliffe.
Jul. Hübner.	Jas. Grant.

F. S. Sinnatt.

Hollins, Cecil,

34, Beamsley Road, Frizinghall, Yorks, or 137, Firs Lane, Leigh, Lancashire.

Assistant Master in the Leigh Grammar School. Akroyd Scholar at the Leeds University, 1902—5. I am desirous of keeping in touch with the latest developments of Chemistry.

Arthur Smithells. W. Lowson.
J. B. Cohen. C. E. Whiteley.
W. H. Leek.

Jack, Maurice Brooks,

66, Burma Road, Clissold Park, N.

Wholesale Druggists, &c. (Manufacturing), Junr. Director. Six years' practical experience in every branch of manufacture of Chemists' and Druggists' sundries, in the making of Pharmaceutical preparations, and of synthetic perfumes ; good general analytical experience. Have devoted most of spare time during past 5 years to study of Chemistry at the City of London College. Holder of Certificates in Chemistry, both Theoretical and Practical, from the City of London College and the Board of Education.

Isaac S. Scarf. Harold W. Harrie.
Charles A. West. *E. J. Jackman.*
J. C. Mascarenhas.

Jones, Edward Towyn,

17, Bloomsbury Square, London, W.C.

Assistant Lecturer in the Dept. of Chemistry and Physics at the School of Pharmacy (Pharmaceutical Society), London. B.Sc. (Wales), with 1st Class Hons. in Chemistry, 1904. Junior Demonstrator of Chemistry at the Univ. College of N. Wales, Bangor, 1904–5. Assistant Lecturer and Demonstrator of Chemistry at the School of Pharmacy (Pharmaceutical Society), London, 1905.

Arthur W. Crossley. James J. Dobbie
Kennedy J. P. Orton. Alexander Lauder.
Allan Baguley. *Charles E. Fawsitt.*

Law, Herbert Drake,

152, Brixton Rd., S.W.

Assistant Lecturer, Borough Polytechnic. B.Sc., 1st Hons. Published work : "Estimation of Nitrogen," Society of Chemical Industry, June, 1902 ; "Electrolytic Oxidation of Aromatic Hydrocarbons," Faraday Society, October 25, 1904 ; "Electrolytic Oxidation of Aldehydes," *Trans.*, February, 1904.

F. Mollwo Perkin. C. H. Desch.
T. Martin Lowry. George Beilby.
Alfd. C. Chapman.

Lyon, Rudolph,

400, Huddersfield Road, Halifax.

Analytical Chemist and Manager of Halifax Sewage Works. Four years under T. Fairley, Esq., F.R.S.E., &c., and five years' experience since as Chemist under The Bradford Dyers' Association, Messrs. Brotherton & Co., Messrs. Murphy and Lonsdale, and the Halifax Corporation.

Thomas Fairley.
A. J. Murphy.
H. W. Watson.
Arthur W. Cooke.
B. A. Burrell.
Edward Halliwell.
H. D. Dakin.
James Ashton.

McCleary, William,

61, Station Road, Pendlebury, Nr. Manchester.

Demonstrator in Practical Bleaching, Dyeing, and Finishing at the Municipal School of Technology, Manchester. First Class in Theoretical and Practical Chemistry. Joint Author in "The Chemistry and Practice of Finishing."

B. Prentice.
J. R. Appleyard.
R. L. Taylor.
Jno. L. Whiteside.
E. Green.
Percy Bean.
Frank Crossley.

MacKechnie, Robert Drysdale,

Sycamore Cottage, Pitsea, Essex.

Technical Chemist. Three years' training in analytical chemistry and allied sciences at Anderson's College, Glasgow; one year's training in Metallurgy at Technical College, Glasgow, subsequently assistant to Dr. A. P. Aitken, Edinburgh; chemist to Messrs. Tennant & Co., of Carnoustie, at present chemist-in-charge at British Explosives Syndicate, Ltd., Pitsea.

Robert J. Caldwell.
Frederick Robertson.
J. Wyclif Black.
J. A. Williamson.
William Robertson.

Martin, Harry,

14, Hardman Street, Liverpool.

Chemist and Druggist. Member of the Pharmaceutical Society. Attended elementary and advanced courses of chemistry under Prof. Norman Collie, F.R.S., &c., at the School of Pharmacy of the Pharmaceutical Society. Later, chief assistant in the wholesale pharmaceutical laboratory of Messrs. Brady & Martin, of Newcastle-on

Tyne. Now Director of Messrs. Symes & Co., Ltd., Liverpool, Manufacturing, Analytical, and Dispensing Chemists. Honorary Secretary of the Liverpool Chemists' Association.

John Norman Collie.
Arthur Lapworth.
M. Carteighe.
N. H. Martin.
Prosper H. Marsden.
John C. Hewlett.
Walter Hills.

Micklewright, Harry George Fletcher,
116, St. James's Road, Croydon.

Science Master at Whitgift Grammar School, Croydon. B.A. Oxon. 1903. 1st Class Final Honour School of Natural Science (Chemistry). I am engaged in teaching Chemistry, and am desirous of keeping in contact with the developments of the science.

W. W. Fisher.
J. E. Marsh.
John Watts.
N. V. Sidgwick.
R. de J. Fleming Struthers.
A. Angel.

Modi, Edalji Manekji,
Opposite Grant Road Station, Sleater Road, Bombay.

Manufacturing and Consulting Chemist and Chemical Analyst and Technologist, Managing Director of the Arthur Road Chemical Works, Bombay, Life Member of the Society of Chemical Industry (London), Member of the Bombay Textile and Engineering Association, Life Member of the Bombay Sanitary Association, &c. After passing University Examinations (theoretical and practical) in Physics, Inorganic and Organic Chemistry, and Toxicology, from the Grant Medical College, Bombay, some 18 years ago, devoting time and energy to chemical pursuits, doing analytical and industrial research work at the Bombay Techno-Chemical Laboratory, since its start, directing for the last 15 years unremitting attention to utilisation of different raw and waste materials produced in India in the successful manufacture (by simple and economical processes) of various chemical products for the Engineering and Textile Industries as well as in the line of Disinfectants, and being the Patentee and Proprietor of numerous useful Specialities largely used and appreciated by H.M.'s Indian Government and numerous leading Mills, Railways, Steamships, &c.

T. K. Gajjar.
K. B. Jadhava.
Gopal C. Banerjee.
A. Pell.
A. Sanyal.
C. L. Bose.
P. C. Rây.

Morris, Eric Haydn-,

c/o Messrs. G. Mowling & Son, Chemical Works, Footscray,
Melbourne, Victoria, Australia.

Assoc. of the Incorporat. Inst. of Analysts, Assayers and Metallurgists of Victoria. Manager and Head Chemist, now and for 2½ years past, at a soap and candle, soap, glycerine and oil works, Melbourne, Australia. I had charge of Messrs. Jos. Crosfield & Sons', Ltd. (alkali, soap, glycerine, and chemical mfrs.) laboratory at Liverpool for two years. During my studentship I attended science lectures at Liverpool University College, also at Liverpool School of Science, Technology and Art. Am now and have been for 3 years Head Chemist and manager to G. Mowling & Son, soap, candle, oil and glycerine manufacturers, Melbourne, Australia. Being engaged in analytical and technical work, I am desirous of joining this society in order to receive their publications and to keep myself abreast of latest chemical researches at home.

A. H. Jackson. *D. Avery.*
Henry W. Levy. *A. W. Craig.*
W. E. Field. *F. R. Power.*
Robert Law.

Motion, John.

Edgewater, N.J.

Chemist. Assist. Chemist with Messrs. J. & P. Coats, Paisley, Scotland, 1891—1895. Assistant Chemist at Parkhead Forge (Steel Works and Rolling Mills), Glasgow, Scotland, 1895—1897. Since 1897, Chemist for Valvoline Oil Co., Edgewater, N.J.

Wm. App Jones. Edward C. Worden.
Benj. L. Murray. T. Lynton Briggs.
Virgil Coblentz.

Neville, Henry Allen Dugdale,

81, Revidge Road, Blackburn, and the County Technical
Laboratories, Chelmsford.

Lecturer and Demonstrator in Chemistry. B.Sc. (Lond.). Associate of the Institute of Chemistry. Formerly Assistant Demonstrator in Chemistry at the Municipal School of Technology, Manchester, and Assistant Lecturer and Demonstrator in Chemistry at the Municipal Technical School, Blackburn. Now Lecturer on Chemistry at the County Technical Laboratories, Chelmsford. Joint author of the following papers in the Journal of the Chemical Society: with R. H. Pickard, D.Sc., Ph.D., "Note on Pyromucylhydroxamic Acid" (1901), with W. J. Pope, F.R.S., "Optically Active Selenium Compounds"

(1902); with R. H. Pickard, D.Sc., Ph.D., "Optically Active Carbimides."

William J. Pope. | Jul. Hübner.
Robert H. Pickard. | A. S. Elford.
Thos. S. Dymond.

Penn, Francis Richard,

Highthorne Tce., Shadwell Lane, Moortown, Leeds.

Teacher of Chemistry. Assoc. R.C.S., Lond. Chemistry, 1st Class, 1893—6. Inter. B.Sc., Lond. First in 1st Class Hons. Chemistry, 1901. Teaching Scholar in Chemistry, R.C.S., Lond., 1896–98. Teacher of Chemistry in Central Higher Grade School, Leeds, 1898—present date. Teacher of Chemistry, &c., to evening students in Technical School of Leeds Institute, 1902—present date.

William A. Tilden. | Chapman Jones.
M. O. Forster. | W. Palmer Wynne.
G. T. Morgan. | Beeby Thompson.
S. Parrish.

Perkins, Hugh Donald,

"Dodwell," Bursledon, Hants, England.

Second Assistant in the Country Liquors Investigation Laboratory. Student at Hartley University College, Southampton, under Dr. D. R. Boyd. Assistant to J. T. Norman, Esq., City Central Laboratory, London. At present engaged under the Indian Government, at Kasauli, Punjab, as above.

R. L. Jenks. | D. R. Boyd.
John T. Norman. | T. E. Thorpe.
J. Brierley.

Phipson, Percy Barker,

c/o J. Staples and Co., Ltd., Wellington, New Zealand.

Brewer and Chemist. Chemist to the City Brewery Company, Lichfield, England, for 2 years, and for the last 4 years have acted as Chemist to J. Staples and Co., Ltd., Wellington, N.Z. My reason for desiring admission to the Chemical Society is that, living in so isolated a position, I am anxious to obtain the Chemical Society's Journal, so as to keep in touch with the latest developments in Chemistry.

H. W. Lawrence. | J. S. Maclaurin.
Thomas H. Easterfield. | *B. C. Aston.*
Geo. M. Thomson.

Pooler, Frederick John,

The Boys' High School, Grahamstown, Cape Colony.

Science Master at above school. B.Sc., Birmingham University, in

Physics, Chemistry, and Maths. Honours, Part II, Theoretical Chemistry, S. Kensington, 1902. For 2¼ years Chemistry Master at the Higher Grade School, Jarrow-on-Tyne. For 5½ years assistant to Dr. R. A. Lyster, B.Sc., M.B., &c., the Technical School, Smethwick, Birmingham. At present Chemistry and Maths. Master at Grahamstown. As a Teacher of Honours Practical Chemistry in N. of England, I met with considerable success, my students being the *only* successful ones for many years in the district.

W. E. S. Turner.
J. Newton Friend.
T. Slater Price.
D. F. Twiss.
Arthur Adams.

Rigby, Thomas,

23, The Square, Fairfield, Manchester.

Chief Engineer, Power Gas Dept. of Crossley Bros., Ltd., Openshaw. A student of Chemistry for some years. Designer of special apparatus for the treatment of guns, armour plates, and the products of various chemical and metallurgical processes. Designer of special gas-producing plants for the utilisation of all kinds of carbonaceous fuels, and has done special research work in these and in the recovery of the original nitrogen in the fuels in various forms, as, for instance, sulphate of ammonia. I wish to have the proceedings of the Society to keep in touch with modern chemical science.

Fredc. H. Bowman.
G. H. Bailey.
W. H. Bentley.
F. W. Skirrow.
Ernest Wheeler.
F. E. Bowman.
Percy Bean.
Frank Crossley.

Rowland, James Frederick Fothergill,

5, St. James's Park, Croydon.

Science Teacher. Am a B.A., Cambridge, and an Internal Student of Lond. Univ., studying for Hons. at B.Sc. in Chemistry. Am Senior Science Master at the Whitgift Middle School, Croydon (350 boys). Have studied Chemistry practically in Dr. Wynter-Blyth's Laboratory, engaged in a research on the distribution of nitrates in the Vegetable Kingdom.

A. Wynter-Blyth.
J. Bernard Coleman.
J. C. Crocker.
F. H. Lowe.
W. E. Oakden.

Royle, Harold Marmion,

12, Barfield Villas, George Lane, South Woodford, Essex.

Chemist at the Gas Light and Coke Co., Beckton Gas Works, Beckton, Essex. Assistant Chemist at Messrs. Johnson Saccharum Co., Ltd., for 18 months. Chemist at the London Distilling and Yeast

Co., Ltd., for 4 years. Chemist at the Beckton Gas Works for 5 years and up to the present time. Object in joining the Society to obtain the current Chemical Literature.

L. J. de Whalley. Thomas Tyrer.
B. E. R. Newlands. *David Howard.*
D. Lloyd Howard.

Ruston, Arthur Gough, B.A., B.Sc. (Lond.),
244, Oxford Road, Reading.

Schoolmaster. Senior Science Master, Kendrick School, Reading. Demonstrator in Chemistry, University College, Reading. Desirous of keeping abreast of Chemical work and perfecting his knowledge of the Science.

C. M. Luxmore. John Percival.
E. K. Hanson. J. W. Dodgson.
C. W. Walker-Tisdale.

Schnurmann, Harry Nestor-,
Corinth House, Cheltenham.

Assistant Lecturer and Demonstrator in Metallurgy to the University of Birmingham. Mining and Metallurgical Education at Redruth School of Mines (Cornwall) and Massachusetts Inst. of Technology, Boston, U.S.A. Author of paper on Micro-structure of Copper (Inst. of M. and M.); co-patentee of Copper Tapping Apparatus, &c.

Thomas Turner. J. Paul de Castro.
Edmund F. Hudson. *Harry Silvester.*
Alex. Findlay.

Setterington, Douglas Temple,
45, Regent Road, Blackpool, Lancs.

Teacher of Chemistry. Inter. B.Sc. (London). Lecturer in Chemistry at the Blackpool Secondary School, P. T. Centre and Technical School. Author of "Easy Quantitative Exercises in Chemistry."

Frank E. Weston. Morton E. Wager.
Henry R. Ellis. J. Hart-Smith.
John Wilson.

Tillot, John Booty,
55, Wood Street, Westminster, S.W.

Analyst. Pharmaceutical Chemist. Member of Pharmaceutical Society. Scientific training received at Borough Road and Chelsea Polytechnic Institutes. At present engaged in analytical work in conjunction with A. E. Bell, Esq., F.I.C., F.C.S.

Albert Edward Bell. H. F. Brand.
F. Mollwo Perkin. *John C. Umney.*
W. A. H. Naylor.

Tutin, Frank,
49, The Avenue, Kew.

Research Chemist in the Wellcome Chemical Research Laboratories. Joint author of papers published in the Society's Journal.

Frederick B. Power.
R. M. Caven.
F. Stanley Kipping
H. A. D. Jowett.
Frederic H. Lees.

Walpole, George Stanley,
349, Queen's Rd., Battersea Pk.

Research Chemist. Bachelor of Science, Melbourne University (1st Hons. Chemistry). Author of Paper, *Proc. Roy. Soc., Victoria*, Vol. XVII, Pt. II, Article XIV. Research Studentship, Lister Institute of Preventive Medicine, Chelsea, 1905.

Henry E. Roscoe.
Harold G. Colman.
Arthur Harden.
J. Norman Collie.
J. Paul de Castro.

White, John Ledger,
73, Cambridge Mansions.

Assistant Lecturer in Chemical Department, Battersea Polytechnic, S.W. D.Sc. (Durham) in Chemistry. Two years Private Assistant to Professor Bedson, D.Sc., &c.; one year Works Chemist to Messrs. Addison, Potter & Sons; two years Assistant Lecturer and Demonstrator, Armstrong College; seven years Assistant Lecturer and Demonstrator, Battersea Polytechnic.

P. Phillips Bedson
J. T. Dunn.
F. C. Garrett.
John Wilson.
S. Hoare Collins.

Williams, Gerard William,
P.O. Box 21, Germiston, Transvaal, S.A.

Metallurgical Chemist. Consolidated Goldfields of S.A., Ltd. Cambridge, 1898, 1900. 1st Class Nat. Science, Tripos, 1900. Journal of Chemical, Metallurgical, and Mining Soc. of S.A. Papers on "The Determination of Constants in Working Cyanide Solutions."—Gold Medal. Also paper on other matters in connection with cyanide process, &c.

W. A. Caldecott.
W. H. Jollyman.
James Moir.
H. J. H. Fenton.
W. J. Sell.

The following Certificates were authorised for presentation to ballot by the Council under Bye-Law I (3) :—

Anthony, Charles, jun.,

Town Hall, East London, C.C., South Africa.

Civil Engineer and Water-Supply Expert; M. Inst. C.E., M. Am. Soc. C.E., Mem. San. Inst., F.R.A.S., &c. Received chemical training at the Royal School of Mines, Bristol, and subsequently at the University Laboratory, Cambridge. When in the Argentine the Government placed the Mint Laboratory at his disposal.

Robert Warington. *A. John Gregory.*
Charles Mills. *Walter D. Severn.*

Millen, John Dunlop,

Launceston, Tasmania.

Metallurgist and Metallurgical Chemist, Mount Bischoff Co. Fellow of the Geological Society, Associate of the Sydney Technical College, Lecturer at the Launceston Technical College in Chemistry, Metallurgy, &c.

George Stone. *F. B. Guthrie.*
Henry G. Smith.

Rowley, Henry,

Perth, Western Australia.

City Analyst and Bacteriologist. Twenty-five years' experience investigative chemistry. Electro-metallurgy and research engineering; gold extraction and deposition of metals; chlorine processes, &c. (assistant, Prof. Cosmo Newberry). Lecturer Government Technical Schools, Tasmania, Electricity, Electro-Chemistry, and Metallurgy. Ex-Examiner in Practical Chemistry to Pharmaceutical Society, West Australia. Member Inst. Elect. Eng., London. Member Soc. Pub. Analysts, London.

Edward S. Simpson. F. S. Earp.
Percy Appleyard.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK

Issued 15/12/05

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 301.

Thursday, December 7th, 1905, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Mr. T. W. Firth Clark was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

George Ernest Banner, Brooklyn, Highfield Rd., Rock Ferry, Cheshire.
Arthur Ernest Barker, B.A., B.Sc., 3, York Rd., Chorlton-cum-Hardy.
Charles Frederick Polwhele Bletchley, B.A., Downside College, Bath.
Arthur Forbes Braid, Rose Mount, Dumbreck, Glasgow.
William Caldwell, M.A., Mont-Cecil, Bloomfield, Belfast.
Reginald William Lane Clarke, 15, Torridon Rd., Hither Green, S.E.
William Boulton Conyingham, "Sandon," Ballsbridge, Co. Dublin.
Frederick Watkins Evans, 3, Charlotte Street, Hull.
Hans Eduard Fierz, Ph.D., Clydach-on-Tawe, Glamorg., Wales.
William Henry Matthews Jones, Leyden Villa, Chester.
George Frederick Wesley Martin, 14, Castle Park, Lancaster.
John Edmund Pitman, B.Sc., Hartley Univ. College, Southampton.
Harold Rogerson, M.Sc., 46, Bloomsbury St., Bedford Square, W.C.
Frank Smith, B.Sc., 407, Church Road, Smithills, Bolton.
Percy Charles Thornton, 9, Cantwell Road, Plumstead, S.E.
Ronald William Tonkin, 37, Oakill Road, Putney, S.W.
Elkan Wechsler, Ph.D., 59, Petherton Road, Canonbury, N.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected :

Adam Lawson Kelly Adam.
C. Chester Ahlum.
James Edward Alcock.
James Albert Allison.
Charles Anthony, jun.
George Henry Barbrook.
Marmaduke Barrowcliff.
John Coggin Brown, B.Sc.
Bryce Chudleigh Burt, B.Sc.
Joseph Edward Coates, B.Sc.
Douglas Henry Bellars Cowman.
Arthur Augustine Dallman.
Joseph Morgan Davey.
John Llewelyn Davies, B.A.
John Doull.
Harry Dunlop.
John Beaconsfield Gall.
Sidney Montague Haig.
Alfred Hart, M.A., B.Sc.
Jack Vernon Johnson Hayman.
John Michael Higgins.
William Basil Hill.
Isaac Berkwood Hobsbaum.
Cecil Hollins.
Maurice Brooks Jack.
Edward Towyn Jones, B.Sc.
Herbert Drake Law, B.Sc.
Rudolph Lyon.
William McCleary.
Robert Drysdale MacKechnie.
Harry Martin.
Harry George Fletcher Micklewright, B.A.
John Dunlop Millen.
Edalji Manekji Modi.
Eric Haydn-Morris.
John Motion.
Henry Allen Dugdale Neville, B.Sc.
Francis Richard Penn.
Hugh Donald Perkins.
Percy Barker Phipson.
Frederick John Pooler, B.Sc.
Thomas Rigby.
James Frederick Fothergill Rowland, B.A.
Henry Rowley.
Harold Marmion Royle.
Arthur Gough Ruston, B.A., B.Sc.
Harry Nestor-Schnurmann.
Douglas Temple Setterington.
John Booty Tillot.
Frank Tutin.
George Stanley Walpole, B.Sc.
John Ledger White, D.Sc.
Gerard William Williams, B.A.,

Of the following papers, those marked * were read :

*202. "The constitution of nitrites. Part I. Two varieties of silver nitrite." By Prafulla Chandra Rây and Atul Chandra Gañguli.

It has generally been maintained that silver nitrite has a nitronic or non-oxylic constitution (Divers, *Trans.*, 1883, **43**, 455; 1885, **47**, 205), but Emerson Reynolds seems, however, to be of opinion that "isomeric metallic nitrites of both the types (oxylic and imidic) exist which are also tautometric in a marked degree" (*Trans.*, 1903, **83**, 643).

The close analogy between mercurous nitrite and the corresponding silver compound has all along been pointed out in some of the authors' previous memoirs, and it would appear that under the action of heat the former behaves as if it had a twofold constitution, as indicated by $Hg{\cdot}NO_2$ and $Hg{\cdot}O{\cdot}NO$ respectively (*Trans.*, 1903, **83**, 491).

In the present communication, the authors hope to establish that silver nitrite also has this dual character, the two varieties being now described under the designation of α- and β-compounds respectively.

The α-Variety of Silver Nitrite.—This is the substance prepared by double decomposition between solutions of silver nitrate and sodium nitrite. The precipitate, consisting of a mealy crystalline powder, is drained at the pump, thoroughly washed with cold water, and dried under diminished pressure over sulphuric acid. The method of experiment was exactly the same as already described (*Trans.*, 1905, **87**, 180). In the experiment of Divers and Shimidzu, after the apparatus had been exhausted the flow of mercury in the fall tube was stopped so as to allow the nitrous fumes evolved during the heating of the salt to act on the metallic silver set free, thereby favouring the formation of silver nitrate and nitric oxide (*Trans.*, 1885, **47**, 634). In the present instance, the reverse method was followed. The rate of the flow of mercury was increased during the operation. By this arrangement the nitrous fumes were swept out of the tube almost as fast as they were generated, thus giving them much less chance of coming into contact with the silver. Moreover, these being absorbed by the caustic potash in the spiral, not only was the "soiling" of mercury in the Sprengel pump guarded against, but also the formation of nitric oxide by the secondary reaction between mercury and nitrous fumes prevented.

As it was desirable that the heating should be effected at a definite temperature, an asbestos box was made fitted up with mica windows; when the bath had reached the required temperature, the portion of the glass tube containing the substance was introduced into it through an opening. The various stages in the decomposition could also be easily watched through the mica plates.

The salt, when heated at temperatures ranging between 220° and 250°, fused, evolving red fumes. The gas which was collected in the reservoir of the pump was completely absorbed by a solution of ferrous sulphate, thus proving it to be nitric oxide. The residue solidified into a hard lump, consisting of a mixture of metallic silver and its nitrate. So far as this experiment goes, Divers' results are confirmed. The silver nitrite breaks up according to the equation: $2Ag{\cdot}NO_2 = 2Ag + N_2O_4$ (1); at the same time, a portion of the silver thus set free acts upon the nitrous fumes, giving rise to silver nitrate and nitric oxide: $Ag + NO(NO_3) = AgNO_3 + NO$ (2).

The β-Variety of Silver Nitrite.—The silver nitrite as prepared above is dissolved in boiling water, and from the hot saturated solution the nitrite is allowed to crystallise; when the mother liquor becomes lukewarm, it is decanted into a shallow evaporating dish. When left over-night, slender needles are formed, which are drained and dried as above.

The heating was effected at exactly the same temperatures as in the preceding experiment, namely, between 200° and 250°. Very slight red fumes were noticed, and the substance did not fuse. The gas collected was not absorbed or coloured by a solution of ferrous sulphate, but was completely absorbed by a solution of alkaline pyrogallate, thus proving to be oxygen. As the salt did not fuse, the filamentous character of the original crystals was kept intact; the residue, on treatment with hot water, did not give the faintest opalescence with hydrochloric acid, and, when struck with a hammer, it solidified into a shining regulus of metallic silver.

The results are noteworthy in more respects than one. In the present instance, any formation of silver nitrate is out of the question. This salt is a stable compound, and it decomposes only slightly even at 444° (Divers, *Trans.*, 1899, **75**, 83). It cannot, therefore, be urged that a little silver nitrate is at first formed, which breaks up and yields oxygen according to the equation: $2AgNO_3 = 2Ag + N_2O_4 + O_2$.

The oxylic constitution of silver nitrite, however, offers an easy explanation. Under the action of heat, the scission takes place as indicated by the dotted lines: $\mathrm{Ag}\overset{\vdots}{-}\mathrm{O}\overset{\vdots}{-}\mathrm{NO}$.

Thus, from every two molecules of silver nitrite two molecules of nitric oxide and one molecule of oxygen are simultaneously set free. Now, although a mixture of these two gases in this proportion probably gives rise ordinarily to the peroxide, when it is rapidly drawn through or shaken up with a solution of caustic potash, the whole of the oxygen is not fixed, and a portion of it escapes uncombined. In short, the success of Gay-Lussac's method of preparing potassium nitrite is based on this fact (*Trans.*, 1899, **75**, 85).

It is also remarkable that although a slight quantity of nitrous fumes was noticed, not a trace of silver nitrate was formed under the conditions present. Some dozen experiments were performed with samples of silver nitrite from separate preparations confirming the above results. We give below the result of one typical experiment.

0·43 gram of salt gave 0·3 gram of silver and 35·2 c.c. of moist nitrogen (extracted from the alkali in the spiral) at 32·5° and 754 mm. Found[*] $Ag = 69{\cdot}76$; $N = 8{\cdot}70$; calculated $Ag = 70{\cdot}13$; $N = 9{\cdot}09$ per cent.

The ratio of nitritic to nitratic nitrogen was as 5 : 3·8. The oxygen collected was 2·6 c.c. at the above temperature and pressure.[†]

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[*] The percentages of nitrogen and silver are rather low, but it should be remembered that the crystals, from the method of preparation, necessarily contained a trace of included mother liquor.

[†] If the whole of the oxygen were absorbed, the alkali, on examination, would have yielded nitritic and nitratic nitrogen in equal quantities. A few experiments

In conclusion, the authors wish it to be distinctly understood that a sharp line of demarcation cannot always be laid down between the fusible and the infusible varieties. As a result of experience gained during the course of several dozens of preparations, it has been found that even under exactly similar conditions the α-variety often turns out to be largely admixed with the β-variety; but the evidence of the formation of the latter in the pure state has been unmistakable.

It is to be hoped that further light will be thrown on the constitution of silver nitrite by the determination of specific gravity, as also by interaction with ethyl iodide.

*203. "The products of heating silver nitrite."

By Edward Divers.

One of the purposes of this paper is to show that Rây and Gañguli, in the course of their interesting work on the effects of heating silver nitrite, have met with nothing which supports the belief that there are two chemical varieties of that salt. The other purpose of the paper is to endeavour to increase the confidence in the accuracy of their important experimental results, which are hardly in accordance with current views concerning the oxides of nitrogen.

Accounts of experiments on the effects of heating silver nitrite already published will be found in the following publications (*Trans.*, 1871, **24**, 85; *Proc. Roy. Soc.*, 1871, **19**, 429; and *Trans.*, 1885, **47**, 634; and 1899, **75**, 111). Precipitated and washed silver nitrite seems always to give some nitrate when heated, but, according to Rây and Gañguli, fractional recrystallisation of the precipitated salt, effected by dissolving it in hot water and slowly cooling, gives as the last fraction crystals which may be so heated as to decompose without yielding any nitrate at all. The term fractional crystallisation is here used as appropriate, because the authors state that the salt before recrystallising often behaves as though it were a mixture of its two forms, that which does not give nitrate and that which does, although on what grounds it is difficult to understand. They seem to have

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with lead nitrate under conditions exactly similar to the above were made, the only difference being that the substance was heated to a much higher temperature. The mean of three experiments gave the percentage of nitrogen as nitrate = 4·21, as nitrite = 4·21, whilst the percentage of oxygen was 4·6. According to the equation $Pb(NO_3)_2 = PbO + 2NO_2 + O$, these proportions should be $N = 8{\cdot}48$ and $O = 4{\cdot}84$. Hence it is clearly established that nitric peroxide, even when mixed with oxygen, in reacting on an alkali, yields the nitrate and nitrite in equal amount, the oxygen passing off unabsorbed. A trace of a higher oxide of lead which is found in the intermediate stage in the residue appears from its colour to be red lead (compare Divers, *Trans.*, 1899, **75**, 84). These experiments also prove the trustworthiness of the method employed.

made no inspection of the precipitated salt under the lens, in order to seek for two forms of crystals. No distinction can be made as regards any essential difference between "a mealy crystalline powder" and "slender needles," since the former is only the result of hasty crystallisation during precipitation, and the latter are only obtained by slow crystallisation. The former variety of the salt, we are told, fused when heated at 220° and above; the latter variety did not in the least fuse. This statement cannot, however, be accepted as evidence, since silver nitrite does not fuse, but decomposes freely at about 180°, and will do so quickly and completely at that temperature without any fusion of its products of decomposition taking place. What does fuse in the decomposition of silver nitrite at 220—250° is any silver nitrate produced, this salt melting below 217°.

The remaining difference observed in the nature of the decomposition products of the two forms of silver nitrite supplies, however, no grounds whatever for stating, as Rây and Gañguli have done, that the essential or primary decomposition is into silver and nitric peroxide in the one case, and into silver, nitric oxide, and oxygen in the other, since in this instance the one volume of oxygen and the two of nitric oxide will soon become nitric peroxide also. All that these authors can look to as marking the distinction which they believe to exist, is that they get, exclusive of products common to the two cases, some nitrate and some residual nitric oxide in the one case, whilst in the other, under the same conditions of procedure, they get paler gases and can isolate from them a little oxygen.

There is not much difficulty in finding a sufficient reason for this difference of behaviour in the different way in which the salt will pack itself in the tube in the two cases. When the salt is heated in the state of powder the resulting gases will be temporarily imprisoned in the interstices of the mass and the heat will penetrate it slowly enough to permit of the metallic silver of the already decomposed part being acted on by the gases evolved from the still decomposing parts of the nitrite. In this way nitrate will be formed and the gases made to contain a greater proportion of nitric oxide than would otherwise be the case. If, too, it be assumed that the gases are primarily oxygen and nitric oxide, their detention in the residual mass will give time for their union, more or less, into nitric peroxide and thus account for the redder colour of the resulting gases. On the other hand, when the nitrite is in the form of slender needles, the slight contact of the needles with each other and with the walls of the tube, together with their open arrangement in the tube, will cause the whole mass of the salt to be decomposed so quickly and so nearly simultaneously by the heat suddenly radiated on it from the walls of the heating chamber employed, that, with the vacuum maintained, there will be no temporary detention of the gases by the solids, and no time, therefore, for secondary actions to take place. Not even the production of much nitric peroxide by the union of the oxygen with the lower oxide of nitrogen should be possible before the gases have reached the potassium hydroxide solution.

Rây and Gañguli attempt to strengthen their position that there are two constitutionally different silver nitrites by claiming that, in conjunction with Sen, one of them has shown already (*Trans.*, 1903, **83**, 491) that the decomposition of mercurous nitrite by heat indicates that this salt also has a twofold constitution. They make no reference, however, to the fact that the present writer denied at the time (*Proc.*, 1903, **19**, 78) that they had sufficient grounds for maintaining that view. Much mercurous nitrate was formed in their experiments, along with a very little red oxide, and to the production of this oxide they attached special significance, unmindful of the familar fact that mercurous nitrate itself readily yields mercuric oxide when moderately heated.

Naturally some scepticism will be felt as to the correctness of Rây and Gañguli's implication that oxygen and nitric oxide, mixed in the proportion to form nitric peroxide, can remain for any observable time without passing wholly into combination as that compound. Quite recently, however, any ground for that scepticism has been largely, if not wholly, removed. Raschig (*Zeit. angew. Chem.*, 1905, **18**, 1281) has just shown by convincing experiments that the two gases take only a small, although measurable, fraction of a second to combine to the extent necessary to form, what must be taken to be, nitrous anhydride, thus: $(x+1)O_2 + 4NO = xO_2 + 2N_2O_3$, and that the anhydride then very much more slowly oxidises into nitric peroxide. No difficulty, therefore, need be felt in accepting Rây and Gañguli's results and in believing that in their experiments there was such an outburst of gases from the decomposing silver nitrite—rapidly and uniformly heated in a vacuum to a temperature much above its decomposing point—as to cause the gases to travel 5 cm., or whatever was the distance, to reach the potassium hydroxide solution in a fraction of a second short enough to save some of the oxygen from passing into combination as nitric peroxide. If this be felt to be the case, it will be seen that Rây and Gañguli have indeed done excellent work in their indirect confirmation of Raschig's remarkable discovery of the slow formation of nitric peroxide.

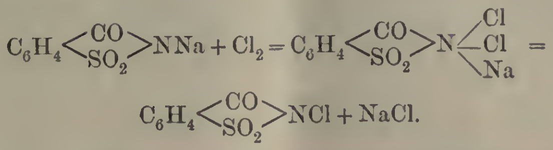
Rây and Gañguli's results being accepted, it must be concluded that when silver nitrite is heated, it always decomposes primarily into silver, nitric oxide, and oxygen, and not that, as these chemists assume, it sometimes also decomposes into silver and nitric peroxide. It has still to be considered how the decomposition must proceed in order that oxygen and nitric oxide may be liberated together. These authors merely suggest that the salt decomposes in the way indicated by the dots in the formula, Ag·O·NO, which, put in that way, does not assist one much. The only explanation apparently possible is that, just as silver nitrate decomposes when heated into oxygen and nitrite, so will the nitrite, in its turn, decompose or tend to decompose into oxygen and hyponitrite, the latter substance almost simultaneously becoming silver and nitric oxide. In support of the possibility of such a change, there is the fact, recorded by the present author (*Proc. Roy. Soc.*, 1871, **19**, 429), that silver nitrite, when decomposed by heat, on one occasion left a minute quantity of a bright yellow silver compound, apparently hyponitrite, which was insoluble in water and soluble in ammonia. As, however, this substance was not again obtained (*Trans.*, 1899, **75**, 111), it is uncertain whether it was really hyponitrite.

DISCUSSION.

The PRESIDENT expressed regret that Dr. Divers had found it necessary to express dissent from the conclusions of the authors of the preceding communication, inasmuch as the salts corresponding to the tautomeric forms of nitrous acid had long been sought for. He was of opinion that no method of determining the constitution of these salts based on the study of their products of decomposition by heat was likely to lead to satisfactory results. He considered that it was by the application of organic reagents in solution, such as the alkyl iodides, that more decisive information was likely to be obtained, and was somewhat surprised that the authors had not made this next comparatively simple step in order to test the accuracy of their conclusions.

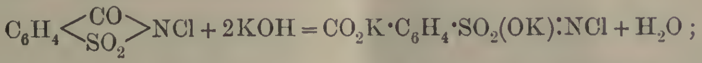
*204. "A contribution to the chemistry of benzoic sulphinide." By Frederick Daniel Chattaway.

In continuation of the author's work on the sulphonamides, the action of chlorine on benzoic sulphinide (saccharin) has been investigated. When chlorine is passed into a solution of saccharin in aqueous potassium or sodium hydroxide, a sparingly soluble solid substituted nitrogen chloride may be precipitated, or the solution may remain clear according as an equivalent quantity of caustic alkali or an excess has been used. In the latter case, on the addition of a mineral acid, a compound is precipitated which may be a sulphondichloroamido- or a sulphonmonochloroamido-acid, according as the chlorine has or has not been added in excess. When chlorine is passed into a solution of the sodium salt of saccharin, *o*-benzoic *N*-chlorosulphinide or chloroiminosaccharin is precipitated in accordance with the following equation :



$$C_6H_4\left\langle\begin{matrix}CO\\SO_2\end{matrix}\right\rangle NNa + Cl_2 = C_6H_4\left\langle\begin{matrix}CO\\SO_2\end{matrix}\right\rangle N\begin{matrix}\diagup Cl\\ \!-Cl\\ \diagdown Na\end{matrix} =$$
$$C_6H_4\left\langle\begin{matrix}CO\\SO_2\end{matrix}\right\rangle NCl + NaCl.$$

This readily dissolves in an excess of caustic alkali, forming a salt of *o*-sulphonchloroamidobenzoic acid, thus :



$$C_6H_4\left\langle\begin{matrix}CO\\SO_2\end{matrix}\right\rangle NCl + 2KOH = CO_2K\cdot C_6H_4\cdot SO_2(OK)\colon NCl + H_2O\ ;$$

the latter, when treated with an excess of chlorine, is converted into the corresponding salt of *o*-sulphondichloroamidobenzoic acid, thus :

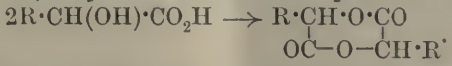
$$CO_2K\cdot C_6H_4\cdot SO_2(OK)\colon NCl + Cl_2 = CO_2K\cdot C_6H_4\cdot SO_2\cdot NCl_2 + KCl.$$

Both of the acids can be liberated from their salts as sparingly soluble crystalline solids on addition of dilute mineral acids.

***205. "The action of heat on α-hydroxycarboxylic acids. Part II. α-Hydroxymargaric acid, α-hydroxypalmitic acid, α-hydroxypentadecylic acid, and α-hydroxymyristic acid." By Henry Rondel Le Sueur.**

When the α-hydroxy-derivatives of margaric, palmitic, pentadecylic, and myristic acids are heated to 270—275°, they decompose with formation of the lactide of the hydroxy-acid and an aldehyde containing one carbon atom less than the original hydroxy-acid, the yield of aldehyde varying between 35 and 50 per cent. of that required by theory. This decomposition is exactly analogous to that undergone by α-hydroxystearic acid when it is heated (*Trans.*, 1904, **85**, 827), and may be represented thus :

$$R\cdot CH(OH)\cdot CO_2H \longrightarrow RCHO + HCO_2H \longrightarrow CO + H_2O.$$



$$2R\cdot CH(OH)\cdot CO_2H \longrightarrow \begin{array}{l} R\cdot CH\cdot O\cdot CO \\ \quad\ \ | \qquad\quad | \\ \ \ OC-O-CH\cdot R \end{array}$$

The aldehydes, which are white solids, readily soluble in the ordinary organic solvents, possess all the properties characteristic of aliphatic aldehydes, that is, they form oximes, semicarbazones, hydroxycyanides, and yield the corresponding acids on oxidation with potassium permanganate.

As the yield of aldehyde is a good one, this method is especially applicable to the preparation of these compounds and also for passing from one acid to the next lower member in the same series.

*206. "Studies on optically active carbimides. Part II. The reactions between *l*-menthylcarbimide and alcohols." By Robert Howson Pickard, William Oswald Littlebury, and Allen Neville.

l-Menthylcarbimide reacts readily with alcohols, and fourteen have been shown to yield *l*-menthylcarbamates, the molecular rotations of the same having an approximately constant value for each solvent. The course of a reaction between the carbimide and an alcohol can be readily followed in the polarimeter. The reaction between ethyl alcohol and the carbimide is bimolecular, the velocity being greatly influenced by the solvent used. When ethyl alcohol is employed as the solvent, the reaction becomes unimolecular, and the velocity constant is approximately proportional to the change of temperature. The velocity constants of the reactions between the carbimide and fourteen alcohols are compared.

*207. "The liberation of tyrosine during tryptic proteolysis. A preliminary communication." By Adrian John Brown and Edmund Theodore Millar.

A method of directly estimating tyrosine by bromination recently described by James H. Millar (*Trans. Guinness Research Laboratory*, 1903, Vol. I, Part I) appeared likely to furnish a means of measuring the activity of proteolytic change in those cases in which tyrosine is liberated during the breaking down of the protein molecule. An investigation in this direction was therefore commenced by the authors and the following is a summary of the results so far obtained.

(1) J. H. Millar's method of estimating tyrosine by bromination is applicable to the estimation of tyrosine in the presence of proteins and their earlier cleavage products due to enzyme action if suitable, control experiments are employed.

(2) Tyrosine is not a late product of tryptic proteolysis, as is usually supposed; on the contrary, the tyrosine nucleus of a protein is attacked, and the whole of the tyrosine liberated during the first stage of tryptic digestion.

(3) The resistance of the protein tyrosine nucleus to peptic hydrolysis is confirmed.

(4) Attention is called to the similarity of Emil Fischer and E. Abderhalden's recent observations on the actions of tryptic and peptic enzymes on polypeptides containing a tyrosine nucleus (*Zeit. physiol. Chem.*, 1905, 46, 52) to the authors' observations on the actions of the same enzymes on proteins containing a tyrosine nucleus.

(5) The authors' investigations appear to indicate a trustworthy means of differentiating enzymes of a peptic from those of a tryptic nature, and may assist in throwing some light on the confused state of knowledge with regard to the existence of a tyrosine nucleus in the different albumoses resulting from peptic and tryptic proteolysis.

208. "Ethyl piperonylacetate." By William Henry Perkin, jun., and Robert Robinson.

When piperonylic acid, $CH_2O_2{:}C_6H_3{\cdot}CO_2H$, is treated with phosphorus pentachloride, it is converted into *piperonyl chloride*, $CH_2O_2{:}C_6H_3{\cdot}COCl$, a colourless, crystalline substance which melts at 80° and distils at 155° (25 mm.). This acid chloride (1 mol.) reacts with the sodium derivative of ethyl acetoacetate (2 mols.) yielding the pale yellow crystalline *sodium* derivative of *ethyl piperonylacetoacetate*, $CH_2O_2{:}C_6H_3{\cdot}COCNa(CH_3{\cdot}CO){\cdot}CO_2Et$; the corresponding *cupric* derivative, $(C_{14}H_{13}O_6)_2Cu$, crystallises from toluene in bluish-green plates. *Ethyl piperonylacetoacetate*, obtained from the pure sodium derivative by treatment with acids, is a colourless syrup which is soluble in sodium carbonate and gives a reddish-violet coloration with alcoholic ferric chloride.

When the sodium derivative is treated with ammonia and ammonium chloride (Claisen, *Annalen*, 1896, **291**, 70), it is decomposed with formation of *ethyl piperonylacetate*, $CH_2O_2{:}C_6H_3{\cdot}CO{\cdot}CH_2{\cdot}CO_2Et$, a solid, crystalline substance which melts at 41°, gives a reddish-violet coloration with ferric chloride, and yields a *copper* derivative, $(C_{12}H_{11}O_5)_2Cu$.

The authors wish to reserve, for a short time, the investigation of these new compounds.

209. "The action of ultra-violet light on moist and dried mixtures of carbon monoxide and oxygen." By Samuel Chadwick, John Edwin Ramsbottom, and David Leonard Chapman.

The chemical effects produced by the passage of the electric discharge through gases are the result of at least three distinct causes, namely, (1) the cathode rays, (2) ultra-violet light, (3) catalytic action of the electrode and in particular the cathode. Ultra-violet light alone has been shown by Lenard to act on oxygen with the formation of ozone. The authors working with a quartz mercury lamp, with which three per cent. of ozone could be produced from pure oxygen, have obtained the following results. A mixture of equal volumes of carbon monoxide and oxygen dried with sulphuric acid and submitted to the action of ultra-violet light, contracted at first slowly, and then more rapidly, until a maximum rate of decrease of volume was attained. The rate of contraction then gradually decreased, and finally became so slow that the experiment was stopped, and the composition of the gases found by analysis. It was ascertained that 22·95 per cent. of the carbon monoxide had been converted into carbon dioxide, and that 39·63 per cent. of the original oxygen had been changed into ozone.

A mixture of equal volumes of carbon monoxide and oxygen dried with phosphoric oxide behaved in almost the same way as the mixture which had been dried with sulphuric acid alone. When the contraction had reached approximately the same value as in the last experiment, it was found on analysis that 19·42 per cent. of the total carbon monoxide had been converted into carbon dioxide, 37·48 per cent. of the original oxygen being this time changed into ozone.

With the same mixture saturated with water vapour at 16°, the result was markedly different. The rate of contraction was practically uniform throughout the experiment, and this rate was less than half the value of the maximum rate with the dried mixture. When the total contraction had reached almost the same value as in the two previous experiments, it was found that 53·2 per cent. of the carbon monoxide had been converted into carbon dioxide, and only 2·6 per cent. of the oxygen into ozone.

If the first action of the ultra-violet light is conceived as consisting of a breaking up of the oxygen molecules into atoms, the atoms of oxygen thus formed prefer to combine with the molecules of carbon monoxide when the gases are moist, but with oxygen molecules when the gases are dry. In the present case, the rate of chemical change, measured by the contraction, is not accelerated by the presence of moisture, but the course of the reaction is determined by the hygroscopic condition of the mixture.

210. "Benzoyl derivatives of salicylamide." By Arthur Walsh Titherley.

Doubt has been thrown by Einhorn and Auwers on the formula $BzO\cdot C_6H_4\cdot C(OH)\colon NH$, attributed by Titherley and Hicks (*Trans.*, 1905, **87**, 1207) to the stable benzoylsalicylamide (m. p. 208°) originally obtained by Gerhardt and Chiozza (*Ann. Chim. Phys.*, 1856, **46**, 139), and which is produced by rearrangement even at 15° from the labile *O*-benzoylsalicylamide, $BzO\cdot C_6H_4\cdot CO\cdot NH_2$ (m. p. 144°), recently isolated by Titherley and Hicks.

Einhorn, in conjunction with Schupp (*Ber.*, 1905, **38**, 2792), and also with Haas (*Ber.*, 1905, **38**, 3628), considers the stable substance to be the

N-benzoyl derivative, $OH\cdot C_6H_4\cdot CO\cdot NHBz$, as also does Auwers (*Ber.*, 1905, **38**, 3256), who regards the rearrangement as due to the wandering of the benzoyl group from O to N: $BzO\cdot C_6H_4\cdot CO\cdot NH_2$ (labile, m. p. 144°) ⟶ $OH\cdot C_6H_4\cdot CO\cdot NHBz$ (stable, m. p. 208°). The change would be analogous to that which takes place when attempts are made to isolate *O*-acyl-*o*-hydroxy-aromatic amines of the type $AcO\cdot C_6H_4\cdot NHR$ and $AcO\cdot C_6H_4\cdot CH_2\cdot NHR$, where rearrangement occurs leading to the production of the *N*-acyl derivatives.

If the *N*-benzoyl formula be ascribed to the substance (m. p. 208°), it must be looked on as possessing anomalous properties; thus, it gives no ferric chloride reaction, is not decomposed by ammonia, like $C_6H_5\cdot CO\cdot NHBz$, and in other ways does not behave like an *N*-benzoyl derivative. Further, on heating with phosphorus oxychloride, it yields benzoylsalicylnitrile, which favours the *O*-benzoyl formula, thus:

$$BzO\cdot C_6H_4\cdot C(OH)\colon NH \longrightarrow BzO\cdot C_6H_4\cdot CN + H_2O.$$

Further investigations are proceeding with a view to elucidating the correct constitution of the substance.

211. "The constitution and colour of diazo- and azo-compounds."

By Arthur Hantzsch.

In the August number of the *Transactions*, Armstrong and Robertson published a paper under the title: "The Significance of Optical Properties as Connoting Structure" (pp. 1272—1297), in which my theory of the stereochemistry of the diazo-compounds is criticised, and the remarkable conclusion expressed, that "the Hantzsch-Werner hypothesis" (in reality, so far as concerns the diazo-compounds, the "Hantzsch hypothesis"), "besides being an intangible and improbable conception, is unnecessary in fact."

If such an expression of opinion were correct, it would certainly not be without some significance, whilst the same holds conversely if such a view is shown to be incorrect, or at all events founded on a false basis. Since the latter is the case, it will be readily admitted that such a refutation ought also to find a place in the Society's publications.

The facts on which I venture to base this statement are simply the various researches on the subject, which I have published in the pages of the *Berichte der deutschen chemischen Gesellschaft*, a synopsis of which is to be found in a small published brochure, "*Diazoverbindungen*," F. Enke, Stuttgart, 1902.

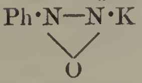
The delay in replying is due to the fact that I only became acquainted with Armstrong and Robertson's work at the beginning of November.

Armstrong and Robertson proceed from the assertion that "all compounds containing the group Ph·N:N·X must be coloured" to the conclusion (p. 1280) that "all compounds of the type Ph·N:N·X should be coloured, and consequently only coloured diazo-compounds can be represented by such a formula. The formulæ assigned by Hantzsch to the so-called normal and *iso*diazotates are at once ruled out of consideration by this argument, as both these classes of compounds are colourless"; in other words, the latter do not correspond to the structural formula Ph·N:N·OK.

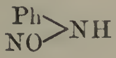
It must first be observed that all chemists from Kekulé onwards, who have worked on diazo-compounds, must therefore have employed an incorrect formula, for they all, before as well as after the discovery of diazo-isomerism, accepted the formula Ph·N:N·OK for at least one of the two isomerides. But apart from this, Armstrong and Robertson's assertion can readily be shown to stand in contradiction to the facts, for according to their views the nature of an azo-compound as such is established by the fact that the compound is a coloured substance, and, conversely, a particular substance cannot be an azo-derivative because it is colourless. Such a conclusion has up to the present proved totally unacceptable, for Thiele's well-known extensive researches (*Annalen*, 1896, **290**, 1) have shown that *both coloured and colourless azo-compounds exist* in the aliphatic series, for instance, the deep red azo-dicarboxylic ester, $CO_2R·N:N·CO_2R$, and the colourless azo-*iso*butyric acid derivatives, $CRMe_2·N:N·CRMe_2$. When Armstrong and Robertson proceed "being colourless, the diazo-salts cannot be formulated as diazene (–N:N–) compounds" (p. 1280), it is certainly logical to assert "that being colourless these so-called azo-compounds of the aliphatic series cannot be compounds of the type –C·N:N·C."

So long, therefore, as Armstrong and Robertson do not offer any explanation of these facts, or substitute other constitutional formulæ for these colourless compounds, regarded generally as azo-derivatives, just so long will their conclusion, namely, "that diazotates being colourless cannot have the ordinary formula Ph·N:N·OK," remain unacceptable. But amongst the diazobenzene derivatives there also exist true chemical compounds containing the group Ph·N:N·X; these, therefore, according to Armstrong and Robertson, must be coloured, but in reality they are colourless. For example, amongst the nitro-*iso*diazobenzene esters we have the nitro-diazo-ester, $NO_2·C_6H_4·N:N·O·CH_3$ (von Pechmann, *Ber.*, 1894, **27**, 672), which, to quote the author's description, "in the pure state is perfectly colourless." Here again it is necessary for them to replace the formula by a more suitable one, or their conclusions must necessarily be regarded as incorrect.

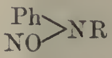
According to their view, "the normal diazotates must perforce be regarded as *diazonium derivatives*"; I do not consider it necessary to disprove this statement, and will content myself by pointing out that even Bamberger has given up the diazonium formula for the labile diazotates (*Annalen*, 1900, **313**, 98), and that his last attempt to rehabilitate it (*Ber.*, 1903, **36**, 4054) has been shown to be unwarranted (*Ber.*, 1904, **37**, 1084).

As regards the proposed formulæ for the *iso*diazotates (p. 1282),  $Ph\cdot\underset{O}{\underset{\diagdown\ \diagup}{N{-}N}}\cdot K$ or $Ph\cdot NK\cdot NO$, the same remarks apply. I discussed these formulæ at length some considerable time ago, and showed them to be unsatisfactory, and they have, as a matter of fact, been abandoned by all chemists who have studied experimentally the chemical behaviour of these substances. The two formulæ of Armstrong and Robertson also stand in contradiction to the fact that the previously-mentioned diazo-ester, $NO_2\cdot C_6H_4\cdot N\colon N\cdot OCH_3$, can be obtained from the *iso*diazotate, so that in consequence the existence of a third hydroxyl form must be accepted. These hydroxyl compounds ($Ph\cdot N\colon N\cdot OH$) are not imaginary tautomeric substances, but real, definite, chemical compounds, for in conjunction with W. Pohl (*Ber.*, 1902, **35**, 2964) I have shown that from the colourless *iso*diazotates there is formed, primarily, the free *iso*-(anti)diazohydroxide as a colourless, true acid, the general behaviour of which certainly indicates the presence of an (OH) group.

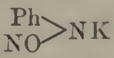
Armstrong and Robertson must therefore suggest another "hydroxyl formula" in place of $Ph\cdot N\colon N\cdot OH$, and the fact cannot be too plainly pointed out that in accepting the nitrosoamine formula for the *iso*diazotates they again immediately stand in contradiction to their fundamental doctrine on the relation of colour to constitution, for, as is well known, most of the true secondary nitrosoamines, and nitrosoamine derivatives, are coloured. The indifferent primary nitrosoamines obtained as *pseudo*-acids by W. Pohl and myself through intramolecular change of the diazohydroxides are also coloured, although as a logical consequence from Armstrong and Robertson's nitrosoamine formula (that is, absence of the group $Ph\cdot N\colon N$) these *iso*diazotates should be colourless if they were really nitrosoamine salts. As is seen from the three formulæ:


$\left.\begin{matrix}Ph\\NO\end{matrix}\right>NH$

1.

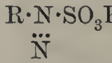

$\left.\begin{matrix}Ph\\NO\end{matrix}\right>NR$

2.


$\left.\begin{matrix}Ph\\NO\end{matrix}\right>NK$

3.

by simple substitution of K for H or R, we obtain from the *coloured* substances (1) and (2) a *colourless* potassium salt (3), a result which is again incompatible with Armstrong and Robertson's theory.[*]

The whole of Armstrong and Robertson's views on the normal diazosulphonates and diazocyanides are quite incorrect. They state (p. 1281) "the action of sulphite may be supposed to involve in the first place the formation of a diazonium sulphonate,  $\begin{array}{l}R\cdot N\cdot SO_3K\\ \;\;\vdots\\ \;\;N\end{array}$," and, so far as I can understand, also put forward the formula $Ph\cdot NH\cdot SO_3K\cdot NOH$. The latter formula is impossible, because most diazosulphonates correspond to the formula $Ph\cdot N_2\cdot SO_3K$; that is, to one containing no water. The diazonium formula itself stands in contradiction to their theory, for if the appearance of colour denotes a change in constitution, and if all the sulphonates of colourless metals (namely, those of silver and mercury) are colourless, why is it that the diazonium sulphonates formed from the colourless diazonium and sulphonic acid components possess an intense orange colour? From the very fact that the labile equally with the stable sulphonates are coloured, they must both be azo-compounds, $Ph\cdot N{:}N\cdot SO_3K$.

The statement that "the so-called *syn*-compound sulphonates and cyanides may well be simple equilibrated mixtures of diazonium cyanides and sulphonates with the stable *anti*-compounds" (p. 1283) is controverted by the facts, for all the normal diazocyanides exhibit analogous behaviour with water and cuprous oxide, but in a manner quite different from that of the *iso*diazocyanides. Further, as regards their colour and constitution, the labile *syn*-diazocyanides and diazosulphonates are always more intensely coloured than the stable *anti*-forms. All diazonium sulphonates are colourless, and all diazosulphonates should be colourless; so that Armstrong and Robertson's view leads to the remarkable result that, by the addition of a colourless to a coloured substance, the colour intensity of the resulting mixture is increased—certainly the greatest *contradictio in adjecto*. In addition, Armstrong and Robertson have not sufficiently taken into consideration the fact that the labile cyanides are distinct chemical compounds possessing definite unchangeable properties, that is, they are not chemical mixtures. The explanation of the change of the *syn*- into the *anti*-form (p. 1281) is impossible by reason of the assumption that an addition of the elements of water takes place, with a subsequent splitting off of the same elements, for in reality many *syn*-sulphonates and very many *syn*-cyanides isomerise in the solid state or in anhydrous solvents.

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[*] The reference to Dobbie and Tinkler's work (*Trans.*, 1905, **85**, 277; and Proc., 1905, **21**, 75), namely, "that the salt $NO_2\cdot C_6H_4\cdot N_2\cdot OK$, in respect to its absorption spectrum, behaves as a nitrosoamine, and not as a diazo-salt," stands in marked contradiction to all its chemical properties. This being so, too much weight cannot be attached to this evidence until it has been ascertained, for example, how the isomeric esters $NO_2\cdot C_6H_4N{:}N\cdot O\cdot CH_3$ and $NO_2\cdot C_6H_4N(CH_3)\cdot NO$ behave under similar conditions, a point which the above-named chemists, at my request, have most kindly promised to investigate.

In short, therefore, the whole of Armstrong and Robertson's conceptions with respect to labile diazo-isomerism are impossible, and their remark that my "*syn-anti*-conception is based upon a false use of the principle of analogy" will certainly be considered as more applicable to their own untenable theories, according to which "the stereochemistry of the diazo-compounds is unnecessary in fact."

With such statements as "in the case of the diazosulphonates, it is clear that they differ essentially in type," put forward without the support of a single experimental fact, equally without any theoretical explanation, discussion is out of the question and, in fact, would be superfluous.

It is unfortunately necessary for me to make an emphatic protest in reference to Armstrong and Robertson's remarks (p. 1280) on the small value which ought to be placed on the analytical results of the labile diazo-isomerides. One has the right to expect that before such statements are made reflecting on the accuracy of the work in question, the greatest care has been taken to verify the facts. That such a sweeping assertion is altogether unwarranted, will, I think, be admitted from a consideration of the following points:

(1) *Labile Diazotates.*—The labile diazotates certainly always contain small quantities of alkali (*Ber.*, 1901, **34**, 2159; 1902, **35**, 2969) or water of crystallisation (*Ber.*, 1895, **28**, 2006; 1896, **29**, 1077), but in the form of their crystalline salts they have been obtained quite pure, so that no chemist who has worked on the subject, from Kekulé onwards to Bamberger, has ever seriously questioned the accuracy of the empirical formula ArN_2OK for the diazotates.

(2) *Labile Diazosulphonates.*—The numerous concordant analyses on these substances (*Ber.*, 1894, **27**, 3529; 1897, **30**, 76, 80—81) prove undoubtedly the accuracy of the formula PhN_2SO_3K for this substance. It is true there is generally present a small quantity of the anti-salt, formed by spontaneous isomerism of the *syn*-derivative, but this certainly does not come into question as affecting the accuracy of the formula or as regards the facts of the isomerism.

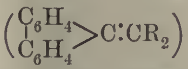
(3) *Labile Diazocyanides.*—The fact must be emphasised that many of these compounds can without difficulty be very readily obtained and isolated in a pure state (*Ber.*, 1896, **29**, 666; 1897, **30**, 2530), so that their constitution as chemically individual substances cannot be doubted. They are not to be regarded, therefore, as "eminently unstable" and "impure," as Armstrong and Robertson assert. As a matter of fact, some of the *syn*-derivatives are so stable as to be only convertible with difficulty into the more stable isomeric *anti*-form.

The undoubted existence of these two classes of compounds (the representatives of the stereo-isomeric azo-compounds), which Armstrong and Robertson do not admit, provides therefore the strongest proof for my stereochemical theory of the diazo-derivatives, a theory supported by a large mass of experimental evidence, in connection with which the theoretical signification has always been carefully pointed out. The reflection by Armstrong and Robertson on the accuracy of this work is altogether unwarranted, and with a thorough knowledge of the subject, it is impossible for me to understand how such assertions could be made.

I am forced to conclude that they have not thoroughly informed themselves in respect to my experimental investigations. Above all, I have to deplore that the numerous exact analytical results already published should thus be brought into discredit, and the stereochemistry of the diazo-derivatives founded on them regarded as "unnecessary in fact"; to be replaced by a view with which the facts, indeed the principle itself, stand in direct contradiction.

In reply to the statement that "I am opposed in principle to conclusions based on optical evidence" (*Ber.*, 1899, **32**, 3149), it is only necessary for me to say that such conclusions in regard to constitution are not warranted from a mere consideration of the optical properties, more especially when those stand in contradiction to the general chemical behaviour of the substance.

It is certainly a very great surprise to me that such a statement should be brought forward, for I have always regarded the physico-chemical behaviour of the substance as of very great importance, and especially in relation to the colour of substances as denoting their constitution. Thus, some eighteen years ago, in conjunction with Hermann (*Ber.*, 1887, **20**, 2801), I was one of the first to draw attention to the relation between colour and constitution in the case of desmotropic substances, and recently, as a result of my researches on pseudo-acids, I have been able to show experimentally that the appearance of colour in the formation of coloured alkali salts from hydrogen compounds is due to an intramolecular change taking place in the position of a hydrogen atom. I intend publishing shortly an account of several researches dealing with the relation of colour to constitution, and in particular establishing the quinonoid structure for nitrophenols, a theory first put forward by Armstrong on very slender experimental evidence, and certainly not accepted by a large number of chemists at the present time.

Summarising, it is my firm conviction that the colour of substances is one of the most important criteria in the characterisation of their constitution, but at the same time it is also one of the most delicate and subtle. Unfortunately, it is in so very many cases quite impossible to explain the origin of the colour, or to account for the remarkable phenomena by structural formulæ. It is only necessary to recall the existence of the coloured fulvene, of the coloured diphenylene-ethylene derivatives  $\left(\begin{array}{l} C_6H_4 \\ | \\ C_6H_4 \end{array}\!\!>C{:}CR_2\right)$ on the one hand, and the colourless polyacetylene on the other; of the coloured derivatives of diethoxynaphthostilbene, dibenzoylethylene, and benzaldesoxybenzoin compared with their colourless isomeric modifications.

In short, as pertaining in particular to the azo- and diazo-derivatives considered in the light of their chemical and physical properties, there exist both *coloured* and *colourless* azo- and diazo-compounds, the cause of which colour is unknown, and which, although representable by Baeyer's valency formulæ (–Ph·N:NR colourless, Ph·N$\approx\approx$N·R coloured), remain still unexplained by any rational structural formulæ. Above all it should not be overlooked that a sharp line of demarcation between coloured and colourless substances does not exist either theoretically or practically; for the same complex appears in an intensely-coloured, a pale-coloured, or a colourless substance, according to the nature of the groups associated with it. Thus, in the case of the aromatic azo-complex Ph·N:N, when this is attached to nitrogen the colour-intensity of the products is less than when it is attached to carbon (thus, Ph·N:N·NH·C_6H_5 possesses a lighter yellow colour than Ph·N:N·CN or Ph·N:N·Ph). It is therefore comprehensible that when the same complex is attached to oxygen (as in the diazotates Ph·N:N·OR) we have a colourless substance formed, more especially as the diazo-compounds containing the group RO·N:N·OR (for example, hyponitrous acid, salts, and esters) are also colourless.

We have accordingly in the following series of colour intensities:

Ph·N:N·OR	Ph·N:N·NHR	Ph·N:N·CN
Colourless.	Pale-coloured.	Intensely-coloured.

a collection of facts which we cannot explain or represent satisfactorily by structural formulæ.

The change of condition from the coloured to the colourless state in azo-compounds is bound up with, but not, however, altogether dependent on, the known structural and stereochemical isomerism of the diazo-derivative, that is, presence or absence of colour is not definitely decided by such isomerism, for whilst both classes of the stereoisomeric diazotates are colourless, both those of the stereoisomeric diazosulphonates and diazocyanides are coloured. Since Armstrong and Robertson's views and formulæ are quite untenable, the older structural and stereochemical formulæ indicate now, as before, the best and most accurate representation of the facts concerning the diazo-compounds.

212. "Note on the incandescent mantle as a catalyst and its application to gas analysis." By John Ernest Mason and John Wilson.

The method described by Lewes (*Chem. News,* 1905, 91, 61) for demonstrating the incandescence of the ordinary gas mantle in a cold mixture of coal gas and air may also be employed with a mixture of ammonia vapour and air. The authors described a modification for showing the incandescence of the mantle in an unburnt mixture of alcohol vapour and air. Although less effective, the mantle may be used as a substitute for platinised asbestos in the ordinary lecture experiments for preparing formaldehyde from methyl alcohol vapour and air, and sulphur trioxide from sulphur dioxide and oxygen.

Fragments of mantle in a hard glass or preferably quartz tube may be used in place of palladium or palladium-asbestos, for the estimation of hydrogen and carbon monoxide in gas analysis by combustion with excess of air or oxygen. Methane and mixtures of methane and hydrogen may be estimated similarly by passing these gases mixed with excess of oxygen over fragments of mantle heated in a quartz tube, and measuring the contraction after combustion and subsequent treatment with caustic potash solution. The results agree well with those obtained by the customary explosion methods. Good results may also be obtained by passing the gases mixed with oxygen over asbestos heated in a small quartz tube. Hydrogen, and less readily methane, may be estimated by passing the gas mixed with oxygen through narrow tubes of heated Jena glass alone.

213. "The influence of certain amphoteric electrolytes on amylolytic action." By John Simpson Ford and John Monteath Guthrie.

An investigation of the influence of asparagine, glycine, and α-alanine on amylolytic action has led to the following conclusions:

(1) Asparagine and the amino-acids mentioned have no specific influence in augmenting the action of amylase; the apparent augmentation of action sometimes obtained by the addition of these amphoteric substances (or of feeble acids) is due to their neutralising alkaline (or other) impurity in the starch or enzyme solution.

(2) Normal amylolytic action takes place in neutral solution. In the plant substance, this neutrality is brought about by equilibrium between the basic and acid products present.

(3) Until the conditions influencing the action of enzymes are more fully established, it is inadvisable to formulate mathematical laws as to the kinetics of enzymic hydrolyses.

(4) Purified soluble starch has the properties of an extremely feeble acid; it is capable of yielding negative ions under the influence of strongly positive ones.

214. "The estimation of picric acid additive compounds." By Frank Sturdy Sinnatt.

The method of Knecht and Hibbert (*Ber.*, 1903, **36**, 1549) for the estimation of picric acid by means of titanous chloride has been found to be applicable to other picrates, and also to picric acid additive compounds.

Twenty-five c.c. of a solution of 0·200 gram of naphthalene picrate in 250 c.c. of alcohol were titrated with titanous chloride, and gave 99·49 per cent. of naphthalene picrate. Pyridine and strychnine picrates yielded 100·19 and 99·69 per cent. respectively.

In many cases it is convenient to dissolve the picrate in hydrochloric acid. The method has been applied to the estimation of naphthalene in coal gas; the naphthalene picrate is separated by the usual process (Colman and Smith, *J. Soc. Chem. Ind.*, 1900, **19**, 128), washed, dissolved in a small volume of alcohol, and titrated with titanous chloride. If a standard solution of picric acid is used in the wash-bottles, the filtrate and washings may also be titrated. The results compare with those obtained by Colman and Smith's method. The estimation of naphthalene and the applications of the titanous chloride process to other picric acid additive compounds are being continued, and the results will be embodied in a further communication.

215. "Silver dioxide and silver peroxynitrate." By Edwin Roy Watson.

A black, crystalline product, obtained at the anode during the electrolysis of an aqueous silver nitrate solution, was considered by Ritter to be silver dioxide, Ag_2O_2 (*Gehlen's Neues J.*, 1804, **3**, 561). Later investigations showed that it could not be regarded as silver dioxide, and a variety of conflicting formulæ have been proposed.

The author has electrolysed aqueous silver nitrate with different current strengths and densities and with solutions of varying concentrations, and has analysed the product formed at the anode in order to see whether this should be regarded as a definite chemical compound or as a mixture, the composition of which varies with different conditions. It was concluded that the product was a definite chemical compound, and that its composition was correctly represented by Sûlc's empirical formula $Ag_7O_{11}N$. The substance is easily decomposed by heat or when left in contact with water or organic matter, such as filter-paper, and to this cause must be attributed the divergent results of the earlier investigators.

This compound, silver peroxynitrate, as it has been termed by Tanatar, on boiling with water decomposes in accordance with the equation $Ag_7O_{11}N = AgNO_3 + 3Ag_2O_2 + O_2$.

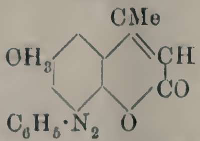
Silver dioxide is a greyish-black powder (sp. gr. 7·44), which may be heated to 100° without decomposition. At higher temperatures it gently decomposes into its elements. It dissolves in hot dilute sulphuric acid in accordance with the equation $2Ag_2O_2 + H_2SO_4 = 2Ag_2SO_4 + 2H_2O + O_2$.

Its behaviour with ammonia is noteworthy, and may be represented in the following manner: $6Ag_2O_2 + 2NH_3 = 3Ag_4O_3 + N_2 + 3H_2O$, so that the compound in solution must be regarded as a polyvalent silver compound, probably $m\mathrm{Ag_4O_3},n\mathrm{NH_3}$.

The dioxide of silver and silver peroxynitrate both dissolve in cold concentrated nitric acid with the production of an intensely brown solution, the colour of which gradually fades even at the ordinary temperature and much more rapidly on warming. The rate of decomposition of the compound is proportional to its concentration in the solution, a fact which makes it impossible to give to the compound the simple formula $Ag(NO_3)_2$. The formulæ $Ag_4(NO_3)_8$ and $Ag_2(NO_4)_2$ are, however, possible.

216. "The constitution of *o*-hydroxyazo-compounds. Preparation of benzeneazodimethylcoumarin." By John Theodore Hewitt and Herbert Victor Mitchell.

The authors have hydrolysed the 4 : 6-dimethylcoumarin described by Pechmann and Cohen (*Ber.*, 1884, 17, 2118), and have coupled the alkaline coumarinate so obtained with phenyldiazonium chloride and the three nitrophenyldiazonium salts.

The alkaline azocoumarinates so obtained are highly coloured, varying in shade from red to violet. On acidification, light-coloured anhydrides of the type  are precipitated.

This instantaneous dehydration indicates the existence of a ready-formed hydroxyl group, even in the *o*-hydroxyazo-series.

Benzeneazo-4 : 6-dimethylcoumarin melts at 199—200°; the *o*-, *m*-, and *p*-nitrobenzeneazo-4 : 6-dimethylcoumarins melt at 240—250° (with decomposition), 212°, and 229° respectively, these melting points being corrected.

217. "**Caro's permonosulphuric acid.**" **By Thomas Slater Price.**

Hitherto it has not been possible to decide between the formulæ H_2SO_5 and $H_2S_2O_9$ for Caro's permonosulphuric acid. The decision could readily be made if a pure salt, for example, the potassium salt, could be obtained. The simplest method would be to heat a weighed quantity of the salt and determine the weight of potassium sulphate left; this weight would depend on whether the formula was $KHSO_5$ or $K_2S_2O_9$.

The author has not yet succeeded in preparing the pure potassium salt, but a mixture has been obtained containing the potassium salts of sulphuric, permonosulphuric, and perdisulphuric acids, and also potassium hydrogen sulphate. It was found possible to determine the amounts of each of the constituents present, and thus calculate the weight of potassium sulphate which would be left on heating up a known weight of the mixture; this could then be compared with the actual weight found. The results obtained point to the formula H_2SO_5 as the correct one.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Alsina, Fernando. Nouvelles orientations scientifiques. Ouvrage traduit du catalan par J. Pin y Soler. pp. 165. ill. Paris 1905. (*Recd.* 4/12/05.) From the Author.

Bagshaw, Walter. Elementary photo-micrography. pp. 68. ill. London 1902. (*Recd.* 22/11/05.) From the Author.

Board of Agriculture. Report on the results of investigations into Cheddar cheese-making, carried out on behalf of the Bath and West and Southern Counties Society in the years 1891—98, by F. J. Lloyd. pp. 251. ill. London 1899. (*Recd.* 22/11/05.)
From F. J. Lloyd, Esq.

—— Report on the results of investigations into cider-making, carried out on behalf of the Bath and West and Southern Counties Society in the years 1893—1902, by F. J. Lloyd. pp. xii + 145. ill. London 1903. (*Recd.* 22/11/05.) From F. J. Lloyd, Esq.

Chapman, Alfred C., and others. The hop and its constituents. A monograph on the hop plant. pp. 99. ill. (*Recd.* 30/11/05.)
From A. C. Chapman, Esq.

Roscoe, Sir Henry Enfield, and Schorlemmer, Carl. A treatise on chemistry. Vol. I. The non-metallic elements. New edition, completely revised by Sir H. E. Roscoe, assisted by H. G. Colman and A. Harden. pp. xii + 931. ill. London 1905. (*Reference.*)
From Sir Henry Enfield Roscoe.

Society of Arts. Report of the Committee on leather for bookbinding. Edited by The Rt. Hon. Viscount Cobham and Sir Henry Trueman Wood. pp. 120. ill. London 1905. (*Recd.* 30/11/05.)
From the Society of Arts.

II. *By Purchase.*

Baumé, Antoine. Chymie expérimentale et raisonnée. 3 volumes. pp. clx + 482, 671, 704. ill. Paris 1773. (*Recd.* 18/11/05.)

Cain, John Cannell, and Thorpe, Jocelyn Field. The synthetic dyestuffs and the intermediate products from which they are derived. pp. xiv + 405. ill. London 1905. (*Recd.* 23/11/05.)

At the next Ordinary Meeting, on **Thursday**, December **21st**, 1905, at **8.30** p.m., the following papers will be communicated :

"The relation of position isomerism to optical activity. Part V. The rotation of the menthyl esters of the isomeric dibromobenzoic acids." By J. B. Cohen and I. H. Zortman.

"Azo-derivatives from α-naphthomethylcoumarin." By J. T. Hewitt and H. V. Mitchell.

"The supposed identity of dihydrolaurolene and of dihydro*iso*laurolene with 1 : 1-dimethylhexahydrobenzene." By A. W. Crossley and N. Renouf.

"The slow combustion of carbon disulphide." By N. Smith.

"The diazo-derivatives of 1 :5- and 1 :8-benzenesulphonylnaphthylenediamines." By G. T. Morgan and F. M. G. Micklethwait.

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PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 21. No. 302.

Thursday, December 21st, 1905, at 8.30 p.m. Professor R. MELDOLA, F.R.S., President, in the Chair.

Messrs. P. W. Robertson, Arthur Slator, J. I. Scott, and E. Towyn Jones were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. :

Thos. Going Stoney Bogue, 5, Kenilworth Square, Dublin.
Stephen Lewis Courtauld, B.A., Bocking Place, Braintree.
Henry Carlyle Irving, B.A., 14, Heath Hurst Road, Hampstead, N.W.
John McDowall, Girdstingwood, Kirkcudbright, Scotland.
John Parkin, M.A., Blaithwaite, Carlisle.
William Hughes Perkins, B.Sc., Harpur Hill, near Buxton.
Philip Foale Rowsell, Nutbrook, Exmouth.
John William Yates, B.Sc., 71, North Street, Hugglescote, near Leicester.

A certificate has been authorised by the Council for presentation to ballot under Bye-Law I (3) in favour of :

Hardolph Wastenays, of Brisbane, Queensland.

Of the following papers, those marked * were read :

*218. "Azo-derivatives from methyl-α-naphthocoumarin." By John Theodore Hewitt and Herbert Victor Mitchell.

The methyl-α-naphthocoumarin, obtained by the condensation of α-naphthol and ethyl acetoacetate, when dissolved in hot caustic alkalis, yields alkali coumarinates, and if these solutions are cooled and treated with the solution of a diazonium salt, coupling takes place in the usual manner. On acidifying the solution, the corresponding azocoumarin is precipitated, and in none of the four cases examined has the formation of an azocoumarinic acid been observed.

The following substances have been prepared: *benzeneazomethylnaphthocoumarin* (m. p. 207°); o-*nitrobenzeneazomethyl naphthocoumarin* (m. p. 268°); m-*nitrobenzeneazomethylnaphthocoumarin* (m. p. 239°); p-*nitrobenzeneazomethylnaphthocoumarin* (m. p. 270—271°). The last of these compounds is remarkable in giving an intense blue coloration in alkaline solution, the alkaline salts derived from the other compounds being orange or red in aqueous solution.

*219. "The preparation and reactions of benzoyl nitrate." By Francis Ernest Francis.

Lachowicz showed (*Ber.*, 1884, 17, 1281) that when benzoyl chloride or other chlorides of the mono- and di-basic organic acids interact with silver or other metallic nitrates, decomposition into oxides of nitrogen and the corresponding organic anhydrides takes place.

If, however, the interaction of benzoyl chloride with silver nitrate is effected at much lower temperatures, oxides of nitrogen are not evolved and benzoyl nitrate is formed:

$$C_6H_5\cdot COCl + Ag\cdot O\cdot NO_2 = C_6H_5\cdot CO\cdot O\cdot NO_2 + AgCl.$$

The product is a light yellow oil which, if carefully warmed, decomposes quantitatively into benzoic anhydride and oxides of nitrogen, but if heated with a free flame this change sets in with explosive violence, the yield of anhydride being much diminished.

Benzoyl nitrate is very rapidly attacked by moisture with the formation of benzoic and nitric acids. When kept at a low temperature either by itself or dissolved in an inert solvent, an interesting change into *m*-nitrobenzoic acid takes place without the formation of either the *o*- or *p*-acid.

Between 0° and −15°, ethyl alcohol and the nitrate give ethyl nitrate, benzene and toluene are converted into their mononitro-derivatives, and phenetole and phenol undergo nitration quantitatively, the product from the former being apparently *o*-nitrophenetole. Methylaniline is nearly quantitatively converted into phenylmethylnitramine, and in all these reactions benzoic acid is simultaneously formed. Aniline, however, gives aniline nitrate and benzanilide. From these observations, it seems probable that benzoyl nitrate will prove to be generally applicable in effecting nitration at low temperatures and in the absence of water.

*220. "The supposed identity of dihydrolaurolene and of dihydro*iso*laurolene with 1 : 1-dimethylhexahydrobenzene." By Arthur William Crossley and Nora Renouf.

The hydrocarbons dihydrolaurolene and dihydro*iso*laurolene have been prepared according to the directions given by Zelinsky and Lepeschkin (*Annalen*, 1901, **319**, 303) and their properties carefully compared with those of 1 : 1-dimethylhexahydrobenzene (*Trans.*, 1905, **87**, 1488). The above-mentioned authors supposed that these three substances were one and the same, but this is not so, for neither dihydrolaurolene nor dihydro*iso*laurolene is identical with 1 : 1-dimethylhexahydrobenzene.

The constitution of dihydrolaurolene is still doubtful, but dihydro*iso*laurolene has been proved conclusively to be a pentamethylene derivative and is 1 : 1 : 2-trimethyl*cyclo*pentane.

*221. "The diazo-derivatives of 1 : 5- and 1 : 8-benzenesulphonylnaphthylenediamines." By Gilbert Thomas Morgan and Frances Mary Gore Micklethwait.

The behaviour of the benzenesulphonyl derivatives of the 1 : 5- and 1 : 8-naphthylenediamines towards nitrous acid has been studied in order to ascertain whether these acylated heteronucleal diamines are capable of yielding diazoimides, and if so to compare the products with the reactive yellow arylsulphonyl*para*diazoimides and the inert colourless acyl*ortho*diazoimides.

Benzenesulphonyl-1 : 8-*naphthylenediamine* (m. p. 166°), obtained by reducing *benzenesulphonyl*-8-*nitro*-α-*naphthylamine* (m. p. 194°), yields a soluble diazonium salt which, by the action of aqueous sodium acetate, gives rise to *benzenesulphonyl*-1 : 8-*naphthylenediazoimide*,

$$C_{10}H_6{:}[N_3]{\cdot}SO_2{\cdot}C_6H_5\,;$$

this product is a well-defined, crystalline, yellow diazoanhydride comparable in every respect with the *para*diazoimides already described by the authors.

This result indicates that the property of yielding these coloured diazoimides is not confined to the *p*-diamine series, and that the characteristic physical and chemical properties of the products do not necessarily arise from the possession of a *para*quinonoid configuration.

as-*Benzenesulphonyl*-N-*methyl*-1 : 8-*naphthylenediamine* and *benzenesulphonyl*-1 : 5-*naphthylenediamine* furnish diazonium salts which are not appreciably affected by aqueous sodium acetate.

*222. "Further experiments on a new method of determining molecular weights." By Philip Blackman.

When working with solvents of high boiling point, the operations (*Trans.*, 1905, **87**, 1474) must be carried out under reduced pressure, this reduction being effected by means of a filter pump.

To prevent ejection of liquid or mixing, due to violent boiling, two bulbs, instead of one, should be introduced into each limb of the inverted U-piece.

Most of the vapours condense in the bulbs ; when a considerable quantity has thus collected in the bulbs, the volumes of the solutions in the test-tubes are observed, care being taken that the liquid in the bulbs does not flow back into the test-tubes during the reading. The liquid is then allowed to return into the tubes, the boiling is repeated, and a reading again taken. This process is repeated as often as is convenient.

A condenser should not be used. Instead of platinum wire, broken pieces of glass were employed. The method works best with volatile solvents, such as acetone (b. p. 56·5—57°), alcohol (96 per cent.), and benzene (b. p. 80—82°).

*223. "Studies in fermentation. The chemical dynamics of alcoholic fermentation by yeast." By Arthur Slator.

The chief results obtained may be summarised as follows :

1. In the study of the rate of alcoholic fermentation, many complications are eliminated by measuring the velocity over very small ranges of the reaction.

2. The change in pressure due to evolution of carbon dioxide is a convenient and sensitive method of measuring this velocity.

3. The rate of fermentation of dextrose is proportional to the concentration of yeast over a wide range of concentrations.

4. The rate is almost independent of the concentration of sugar except in very dilute solutions. The influence of this concentration is never so great that the velocity is proportional to the concentration of the sugar ; the reaction is therefore never one of the first order with regard to the sugar.

5. The temperature-coefficient of the reaction is large, and varies with the temperature. $V_{15}/V_5 = 5{\cdot}6$, $V_{40}/V_{30} = 1{\cdot}6$, and intermediate values are obtained between these temperatures. The temperature quotient for 5° from 5° to 40° forms a series of numbers which seem to be characteristic of the enzyme zymase.

6. The initial rates of fermentation of dextrose, lævulose, sucrose, and maltose are in the ratio 1 : 0·92 : 1·05 : 0·9.

7. The temperature-coefficient of the reaction inhibited by "poisons" is the same as that of the original reaction.

8. It is improbable that any but small quantities of sugar go through the intermediate step of lactic acid in fermentation.

9. These results indicate that the reaction which is measured in these experiments is the slow decomposition of a compound produced by the interaction of the enzyme and the sugar.

*224. "Some new platinocyanides."

By Leonard Angelo Levy and Henry Arnott Sisson.

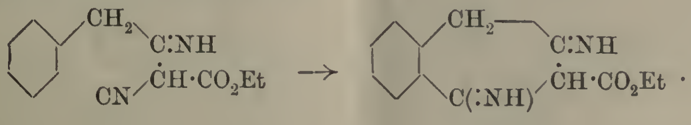
The authors described and gave the results of the analysis of hydrazine and hydroxylamine platinocyanides. These salts form unstable hydrates, which are easily produced by slight changes in temperature. The alteration in the state of hydration is accompanied by striking colour changes.

*225. "An intramolecular change leading to the formation of naphthalene derivatives." By Ernest Francis Joseph Atkinson and Jocelyn Field Thorpe.

Ethyl sodiocyanoacetate condenses with benzyl cyanide to form *ethyl α-cyano-β-imino-γ-phenyl-*n*-butyrate*,

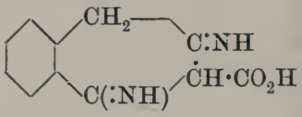
$$Ph{\cdot}CH_2{\cdot}C(:NH){\cdot}CH(CN){\cdot}CO_2Et,$$

a colourless substance crystallising from alcohol in large prisms melting at 125°; its constitution is proved by the fact that on hydrolysis with alcoholic potash it yields phenylacetic and malonic acids. The new imino-ester (I), when treated with an equal weight of cold concentrated sulphuric acid, forms an intense green solution, which, when diluted with water and rendered alkaline with ammonia, gives *ethyl* 1 : 3-*diaminonaphthalene-2-carboxylate* (II), forming intense yellow prisms melting at 104°.

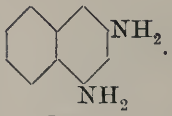


I. II.

The *hydrochloride* forms colourless needles. Ethyl 1 : 3-diaminonaphthalene-2-carboxylate, on treatment with methyl-alcoholic potash, gives a potassium salt from an aqueous solution of which 1 : 3-*diaminonaphthalene-2-carboxylic acid* (III) is precipitated on acidifying with acetic acid.



III.



IV.

The acid forms slightly coloured needles from warm water, which decompose at about 85°, and when heated at this temperature until the evolution of carbon dioxide has ceased are transformed into 1 : 3-naphthylenediamine (IV) which, when recrystallised from dilute alcohol, forms small plates melting at 96°.

The *diacetyl* derivative forms needles from glacial acetic acid melting at 263°.

DISCUSSION.

In reply to questions from Drs. Forster and Morgan, Dr. THORPE stated that the reaction with cold sulphuric acid proceeded very rapidly and was complete after about one minute, the yield being practically quantitative. Hitherto the yield of ethyl α-cyano-β-imino-γ-phenyl-*n*-butyrate only amounted to 25 per cent., but by slightly altering the conditions of the experiment it was hoped that this amount would be largely increased. The temperature at which the condensation was carried out greatly influenced the quantity of the condensation product formed.

226. "The relation of position isomerism to optical activity. V. The rotation of the menthyl esters of the isomeric dibromobenzoic acids." By Julius Berend Cohen and Israel Hyman Zortman.

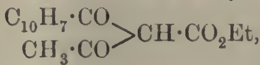
In continuation of previous investigations on this subject (*Trans.*, 1903, **83**, 1213; 1904, **85**, 1262, 1271; 1905, **87**, 1190), the present communication contains an account of certain physical constants, including the molecular rotations of the six isomeric menthyl dibromobenzoates. With the exception of the 2 : 6-ester, the effect on the rotation of the substitution of two bromine atoms is generally less than that of two chlorine atoms, or one chlorine and one bromine, in the same positions. The magnitude of the deviation, beginning with the ester of smallest rotation, is 2 : 6; 2 : 3; 2 : 5; 2 : 4; 3 : 5; 3 : 4;

phenyl. The order is the same as that of the dichloro- and chlorobromo-esters with the exception of the 3 : 4- and 3 : 5-esters, the positions of which in the present case are reversed. The influence of the ortho-bromine atom in depressing the rotation is very clearly indicated in all cases, but most strikingly in that of the 2 : 6-ester, which shows a rotation of $[M]_D^{20^\circ} - 19{\cdot}5^\circ$ compared with the next lowest (2 : 3), which gives $[M]_D^{20^\circ} - 173{\cdot}2^\circ$, or with menthyl benzoate, in which $[M]_D^{20^\circ}$ is $-236{\cdot}3^\circ$.

227. "Some derivatives of naphthoylbenzoic acid and of naphthacenequinone." By Jan Quiller Orchardson and Charles Weizmann.

The authors have investigated a series of condensations which have resulted in the preparation of substitution derivatives of naphthoylbenzoic acid, and from these, by the action of concentrated sulphuric acid, they obtained the corresponding substituted naphthacenequinones.

228. "Ethyl β-naphthoylacetate." By Charles Weizmann and Ernest Basil Falkner.

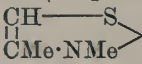
β-Naphthoic acid was converted into β-naphthoyl chloride, $C_{10}H_7{\cdot}CO{\cdot}Cl$, by treatment with phosphorus pentachloride, and this chloride was then allowed to react with the sodium derivative of ethyl acetoacetate. The *ethyl β-naphthoylacetoacetate*,  $\begin{matrix} C_{10}H_7{\cdot}CO \\ CH_3{\cdot}CO \end{matrix}\!\!>\!CH{\cdot}CO_2Et$, melted at 57°, and when digested with ammonia and ammonium chloride yielded *ethyl β-naphthoylacetate*, which melted at 34° and gave rise to a *hydrazone* (m. p. 95°).

229. "Contributions to the chemistry of the amidines. 2-Aminothiazoles and 2-imino-2 : 3-dihydrothiazoles. 2-Iminotetrathiazoles and 2-amino-4 : 5-dihydrothiazoles." By George Young and Samuel Irwin Crookes.

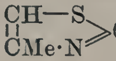
It was shown that the alkylation of amidines belonging to the thiazole group which have one of the nitrogen atoms and the carbon atom of the group $-N{\vdots}C{\cdot}N{\vdots}$, forming part of a closed chain, whilst the other nitrogen atom lies outside the cyclic nucleus, leads to the formation of derivatives in which the alkyl group is attached to the nitrogen atom of the nucleus, except when the ring is already partially reduced and an aryl group is attached to the nitrogen atom of the side-chain, to which, in this case, the alkyl group becomes attached. Methylation of an amidine takes place by addition of methyl iodide and subsequent elimination of the hydrogen haloid.

The following substances were described:

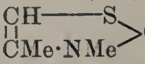
Acetyl-2-anilino-4-methylthiazole, $C_{10}H_9N_2SAc$, forms clusters of soft, white needles (m. p. 114·5°); 2-phenylimino-3 : 4-dimethyl-2 : 3-dihydrothiazole,



$\left.\begin{array}{l}\mathrm{CH}\text{——}\mathrm{S}\\ \parallel\\ \mathrm{CMe{\cdot}NMe}\end{array}\right>\mathrm{C{:}NPh}$, separates in small, white crystals (m. p. 65—66°) and forms a *platinichloride* (m. p. 189—190°). 2-*Allylamino*-4-*methylthiazole*,

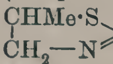


$\left.\begin{array}{l}\mathrm{CH}\text{—}\mathrm{S}\\ \parallel\\ \mathrm{CMe{\cdot}N}\end{array}\right>\mathrm{C{\cdot}NH{\cdot}C_3H_5}$, crystallises in long, white needles (m. p. 40—41°) and forms an *acetyl* derivative (m. p. 36—37°). 2-*Allylimino*-3 : 4-*dimethyl*-2 : 3-*dihydrothiazole*,



$\left.\begin{array}{l}\mathrm{CH}\text{——}\mathrm{S}\\ \parallel\\ \mathrm{CMe{\cdot}NMe}\end{array}\right>\mathrm{C{:}N{\cdot}C_3H_5}$, is a slightly red, viscid oil which forms a *hydriodide* (m. p. 116—117°). The *silver* derivative of 2-acetylimino-4-methyl-2 : 3-dihydrothiazole yields, on methylation, 2-acetylimino-3 : 4-dimethyl-2 : 3-dihydrothiazole (m. p. 113°); 2-methylamino-4-methylthiazole (m. p. 64°) yields, on methylation, 2-methylimino-3 : 4-dimethyl-2 : 3-dihydrothiazole hydriodide (m. p. 164°).

2-Phenylimino-5-methyltetrahydrothiazole forms a *silver* derivative decomposing at 130° and an *acetyl* derivative melting at 47°; 2-phenylmethylamino-5-methyl-4 : 5-dihydrothiazole picrate forms soft, yellow needles (m. p. 114—115°); 2-*phenylethylamino*-5-*methyl*-4 : 5-*dihydrothiazole*,



$\left.\begin{array}{l}\mathrm{CHMe{\cdot}S}\\ |\\ \mathrm{CH_2}\text{—}\mathrm{N}\end{array}\right>\mathrm{C{\cdot}NEtPh}$, is oily and forms a *platinichloride* decomposing at 156°.

A similar series of compounds, in which the *p*- and *o*-tolyl groups replace the phenyl group of the foregoing substances, has also been prepared.

When successively oxidised and hydrolysed, the 2-arylalkylamino-5-methyl-4 : 5-dihydrothiazoles yield β-methyltaurine, which melts at 284—285°, and the corresponding arylalkylamine.

230. "The action of water on diazo-salts." By John Cannell Cain and George Marshall Norman.

The authors have extended the work already briefly described (*Proc.*, 1905, **21**, 206) to the examination of the diazo-salts from 2 : 4-dibromoaniline and dibromo-*p*-toluidine ($CH_3 : NH_2 : Br : Br = 1 : 4 : 3 : 5$), and in each case were successful in obtaining the corresponding substituted phenols. The results of a series of researches carried out during the past four years by the author and his assistants have been summarised.

231. "Note on the atomic weight of nitrogen."

By Alexander Scott.

By the titration of ammonium bromide against silver, the author (*Trans.*, 1901, **79**, 154) obtained results which differed notably from those of Stas, although the values from the chloride seemed to agree somewhat better. These values were:

NH_4Cl	= 53·532 (Stas)	53·516 (Scott)
N	= 14·045 („)	14·029 („)
NH_4Br	= 98·032 („)	97·995 („)
N	= 14·047 („)	14·010 („)

Stas' values for the atomic weight of nitrogen agree with one another, whilst those of the author do not. These values depend, however, on the correctness of the atomic weights taken for chlorine and for bromine, which were assumed to be 35·457 for chlorine and 79·955 for bromine.

By the recent determinations of T. W. Richards and R. C. Wells ("A revision of the atomic weights of sodium and chlorine," 1905), published by the Carnegie Institution of Washington, the want of agreement in the author's values has been completely cleared up and the discrepancy (to an equal extent) transferred to the determinations made by Stas. They prove that Cl = 35·473.

The work of the author was criticised last year by T. W. Richards (*Proc. Amer. Phil. Soc.*, 1904, **43**, 116), who maintained that 14·01 was too low for the atomic weight of nitrogen, and at the end of his paper he states that "It seems probable that the atomic weight of nitrogen is not less than 14·02 and not over 14·04, probably being nearer to the latter value than to the former."

The physical work of Lord Rayleigh and of Leduc on this problem as well as the chemical and physical work of Guye and his co-workers and of R. W. Gray (*Trans.*, 1905, **87**, 1601) all render the conclusions of Richards quite untenable. It is most interesting that the author's critic should, by his own work, have brought the values of the author which are cited above completely into line with those of other recent workers. Using 35·473 instead of 35·457 for the atomic weight of chlorine as above, the author's values for the atomic weight of nitrogen become 14·013 from the chloride and 14·010 from the bromide. When it is remembered that only one gravimetric and two volumetric determinations were made with the chloride, closer agreement could not be expected, and the value 14·010 deduced from the large number of experiments made with the bromide seems completely established.

With regard to the suggestion that the low value found by the author for the bromide was due to his hydrobromic acid containing chlorine, the results given in his paper on the preparation of pure hydrobromic acid (*Trans.*, 1900, **77**, 651) are a sufficient answer. The bromine used was purified by the method given by Stas, by solution in potassium bromide with the addition of zinc oxide. It ought to have been stated that the silver used in experiment VI (*b*) (*Trans.*, 1901, **79**, 152) was cleaned by acid, as recommended by Richards, after fusion on lime and before it was heated in hydrogen.

232. "The solubility of zinc hydroxide in alkalis."
By James Moir.

When the precipitate of zinc hydroxide dissolves in excess of caustic alkali, the phenomenon is essentially an equilibrium between the alkali and zincic acid, and this equilibrium may be reached from both sides: (1) addition of excess of zinc hydroxide to caustic alkali, and (2) dilution with water of a strong solution previously saturated with zinc hydroxide. In the latter case, some of the hydroxide is reprecipitated and an equilibrium is slowly reached, which, as in the first case, depends solely on the concentration of the free alkali.

Observations have been made on both lines over the range from $7N$ to $0{\cdot}01N$ alkali, below which the amount of zinc dissolved is insignificant, being little greater than that due to the solubility of zinc hydroxide in pure water. In addition, the author has succeeded in showing that the experimental results can be deduced from the ordinary assumptions of the ionic theory, so that it follows that the solubility of zinc hydroxide in alkali depends solely on the concentration of hydroxidion in the solution.

It is also shown that no definite chemical compounds (such as $ZnO,8KOH$) exist, since the curve obtained by plotting the results is approximately a parabola, and its tangent never passes through the origin.

A practical result of the investigation is to show that in working cyanide solutions scarcely any of the zinc is present as zincate, but nearly all is zincocyanide.

The formula, giving the dissolved zinc in terms of the concentration of alkali, is $y = 0{\cdot}004x\left(\frac{79x+6}{x+2}\right)$, where y and x are expressed in gram-molecules.

The following list gives a comparison of calculated values of y with those obtained by interpolation from the experimental curves:

(1)	7·5N	NaOH, $x=7{\cdot}5$,	y calculated =	1·89,	y observed =	1·692
(2)	5·5N	KOH, $x=5{\cdot}5$	,,	1·291,	,,	1·36
(3)	2·5N	NaOH, $x=2{\cdot}5$	,,	0·452,	,,	0·48
(4)	2·0N	KOH, $x=2{\cdot}0$	,,	0·328,	,,	0·32
(5)	1·5N	KOH, $x=1{\cdot}5$	,,	0·2033,	,,	0·21
(6)	1·3N	NaOH, $x=1{\cdot}3$	,,	0·171,	,,	0·17
(7)	1N	KOH, $x=1$	,,	0·1132,	,,	0·110
(8)	0·5N	NaOH, $x=0{\cdot}5$	,,	0·0364,	,,	0·040
(9)	0·1N	NaOH, $x=0{\cdot}1$	,,	0·00265,	,,	0·0035
(10)	0·05N	NaOH, $x=0{\cdot}05$	,,	0·00097,	,,	0·0010
(11)	0·01N	NaOH, $x=0{\cdot}01$	,,	0·000135,	,,	0·0002

The theoretical results are usually a little too low, which points to a small error in the value of the constants assumed; but on the whole the agreement between theory and practice is as good as could be expected considering that the experiments were not made at absolutely constant temperature. This agreement cannot be fortuitous, and vindicates the correctness of the assumptions made at the beginning regarding the constitution of zincate solutions and the applicability of the ionic theory. They show also that the whole phenomenon is not one of the formation of definite chemical compounds, but is purely conditioned by the strength of the alkali.

Some of the experimental results are abnormal, especially those obtained by diluting a strong saturated zincate solution. This effect is due to the persistence of the state of supersaturation. The reactions $K_2ZnO_2 + H_2O \longrightarrow KHZnO_2 + KOH \longrightarrow H_2ZnO_2 + 2KOH$ have evidently slow velocities, nevertheless the hydrolysis is eventually very complete, and, ultimately, the same result is obtained as if alkali of the final concentration had been treated with excess of zinc hydroxide. Zinc hydroxide, acting as zincic acid, has therefore a different constant of dissociation from its ordinary basic one, and, in fact, the constant of the equation $(H^{\cdot})(HZnO_2{}') = K.(H_2ZnO_2)$ is rather less than that of water, a fact which accounts for the extensive hydrolysis of the salts of zincic acid.

233. "The slow combustion of carbon disulphide."

By Norman Smith.

Experiments have been carried out in order to determine the composition of the reddish-brown deposit formed when carbon disulphide and oxygen are passed through a heated tube (compare Turpin, *Brit. Assoc. Reports*, 1890, 776; Dixon and Russell, *Trans.*, 1899, **75**, 603). The deposit consists chiefly of an acidic compound $C_{16}H_6O_4S_8$. Another acidic substance or substances containing less carbon and more sulphur than the foregoing product, and very small quantities of free carbon and sulphur, are also found to be present. The silver and ammonium salts of the compound $C_{16}H_6O_4S_8$ have been prepared. The gaseous products consist chiefly of sulphur dioxide with small amounts of carbon dioxide.

At the next Ordinary Meeting, on **Thursday**, January **18th**, 1906, at **8.30** p.m., the following papers will be communicated :

"The refractive indices of crystallising solutions with especial reference to the passage from the meta-stable to the labile condition." By H. A. Miers and F. Isaac.

"The determination of available plant food in soils by the use of weak acid solvents. Part II." By A. D. Hall and A. Amos.

"The action of ammonia and amines on diazobenzene picrate." By O. Silberrad and G. Rotter.

"The preparation of *p*-bistriazobenzene." By O. Silberrad and B. J. Smart.

"Gradual decomposition of ethyl diazoacetate." By O. Silberrad and C. S. Roy.

"Studies on nitrogen iodide. Part III. The action of methyl and benzyl iodides." By O. Silberrad and B. J. Smart.

"Silicon researches. Part X. Silicon thiocyanate." By J. E. Reynolds.

"The relations between absorption spectra and chemical constitution. Part I. The chemical reactivity of the carbonyl group." By A. W. Stewart and E. C. C. Baly.

"Halogen derivatives of substituted oxamides." By F. D. Chattaway and W. H. Lewis.

"The effect of constitution on the rotatory power of optically active nitrogen compounds. Part I." By Miss M. B. Thomas and H. O. Jones.

"Menthyl benzene sulphonate and menthyl-β-naphthalene sulphonate." By T. S. Patterson and J. Frew.

"An apparatus for the continuous extraction of liquids with ether." By R. S. Bowman.

"Action of bromine on benzeneazo-*o*-nitrophenol." By J. T. Hewitt and N. Walker.

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REPORT OF THE COUNCIL.

The Council have the satisfaction of being able to report that the past year has been a prosperous one for the Society, the activity of which, as measured by the number of papers read and the number of Fellows on the list, has exceeded that of any previous year.

On the 31st December, 1904, the number of Fellows was 2,711. During 1905, 164 Fellows were elected and 2 reinstated, thus making a gross total of 2,877. The Society has lost 25 Fellows by death, 28 have resigned, the election of 3 has become void, 1 has withdrawn, and 35 have been removed for non-payment of Annual Subscriptions. The total number of Fellows, therefore, on the 31st December, 1905, was 2,785, showing an increase of 74 over the number for the previous year.

The names of the deceased Fellows, with the dates of their election, are:

W. Ackroyd (1897).
C. M. Blades (1885).
J. F. Braga (1881).
G. B. Buckton (1852).
J. L. Bullock (1842).
C. F. Burnard (1849).
J. H. Calvert (1871).
H. S. Carpenter (1875).
J. Duncan (1863).
H. S. Elworthy (1886).
J. Epps (1885).
E. Graham (1895).
W. H. Greenwood (1873).
F. W. Harrold (1891).
F. M. Mercer (1884).
M. Prasad (1903).
A. B. Prescott (1876).
W. T. Rickard (1845).
R. Roose (1886).
F. Shapley (1893).
C. W. Sutton (1884).
C. R. C. Tichborne (1863).
L. White (1862).
W. W. Will (1885).
R. Yates (1874).

The following Fellows have resigned:

J. Ball.
S. Barlet.
G. E. P. Broderick.
C. J. Brooks.
A. J. Carrier.
F. E. Catchpole.
C. Childs.
C. G. Cresswell.
J. Dennant.
H. Goodier.
H. P. Harris.
J. H. Hichens.
S. Hill.
A. Houston.
C. Hunt.
J. T. Johnson.
H. W. Kinnersley.
W. Lang.
H. W. Lawrence.
F. H. Lescher.
W. H. Martin.
J. Percival.
W. S. Rowntree.
T. Samuel.
C. E. S. Sherratt.
W. J. Stainer.
G. R. Tweedie.
T. E. Vasey.

The small number of Fellows still living who were elected in the early days of the Society has been further reduced by the death of Mr. G. B. Buckton, who was elected in March, 1852, and of Mr. J. L. Bullock, elected in 1842. Since the close of 1905, the Society has had to lament the loss of Professor Hermann Johann Philipp Sprengel, who was elected in December, 1864.

The number of Honorary and Foreign Members at the date of the last Annual General Meeting was 35. No names have been added to the list since then, but the Society has sustained a loss in the death of Professor P. T. Cleve, who was elected in February, 1883, and who died on June 18th, 1905. The work of the deceased Honorary and Foreign Member is to be commemorated by a Memorial Lecture, the delivery of which has been undertaken by Professor T. E. Thorpe.

During the year 1905, 233 scientific communications have been made to the Society, 191 of which have been published already in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The volume of Transactions for 1905 contains 1,936 pages, of which 1,818 are occupied by 184 memoirs, the remaining 118 pages being devoted to the Wislicenus Memorial Lecture, the Obituary Notices, the Report of the Annual General Meeting, and the Presidential Address; the volume for the preceding year contains 175 memoirs, which occupy 1,715 pages.

The Journal for 1905 contains also 4,356 abstracts of papers published mainly in foreign journals, which extend to 1,828 pages, whilst the abstracts for 1904 numbered 4,617, and occupied 1,920 pages.

The abstracts for 1905 may be classified as follows:

	Pages.	No. of Abstracts.
Part I.		
Organic Chemistry	956	1,727
Part II.		
General and Physical Chemistry		619
Inorganic Chemistry		562
Mineralogical Chemistry		71
Physiological Chemistry		467
Chemistry of Vegetable Physiology and Agriculture		295
Analytical Chemistry		615
	872	2,629
Total in Parts I. and II.	1,828	4,356

In making comparison with the preceding year, it must be borne in mind that the 1904 volume contained the abstracts for thirteen months. Owing to the change in date of publication, no abstracts appeared between December 1st, 1903, and January 31st, 1904, so that the number of the Journal published on the latter date contained practically the abstracts of two months (see *Trans.*, 1905, **87**, 539).

The Council regrets to announce that Dr. G. T. Morgan has found it necessary to resign the post of Editor of the Society's publications, which he has occupied so creditably since the beginning of 1903. Although his resignation was received in September, 1905, Dr. Morgan kindly acted as Editor until the appointment of his successor, Dr. J. C. Cain.

The second part (Subject Index) of the Collective Index for the decade 1893–1902 was issued in December, 1905, to those Fellows who had made application for it in accordance with the printed notices circulated with the monthly parts of the Journal subsequently to July, 1903, and the Council have pleasure in expressing the high appreciation of the ceaseless energy displayed by the Indexer, Mrs. Margaret Dougal, on the completion of this valuable work.

During the vacation of 1905, advantage was taken of the Doctorial Jubilee of Professor Adolph von Baeyer, and of the Professorial Jubilee of Professor Mendeléeff, to address letters of congratulation to these two distinguished Honorary and Foreign Members.

In June, 1905, the Council decided that the Ordinary Meetings of the Society should be held during the ensuing Session on the first and third Thursdays of the month at 8.30 p.m. The experiment of holding the meetings on Wednesday afternoons at 5.30 p.m., alternately with Thursday evenings at 8 p.m., had been in operation since January, 1902, and from the fact that the average attendance of Fellows at the afternoon meetings had undergone steady diminution during this period, whilst the number of Fellows attending the evening meetings had increased, it has been concluded that a majority of the Fellows who make a practice of attending the meetings find the evening more convenient than the afternoon.

The Library has received an important addition by the generosity of Sir Henry E. Roscoe, who has presented to the Society a collection of nearly one hundred alchemical and early chemical works of great interest and value.

An increase in the use of the Library is recorded, 1,108 books being borrowed during 1904, as against 1,057 in the previous year. Additions to the Library, excluding Sir Henry Roscoe's donation, comprise 165 books, of which 58 were presented, 324 volumes of periodicals, and 48 pamphlets, as against 119 books, 296 volumes of periodicals, and 52 pamphlets last year. On the recommendation of the Library Committee the Council have made an addition to the Library Rules in the following terms: "No persons other than Fellows of the Society have the privilege of using the Library, except upon a written introduction from a Fellow, with whom rests the responsibility for all books consulted by the person introduced. Such introduction shall be valid for one occasion only."

Grants amounting in all to £236 have been made during the year from the Research Fund, and £22 15s. 3d. has been returned. Of the papers published in the *Transactions* during 1905, 24 were contributed by authors to whom grants had been made from the Research Fund.

In February of last year the Treasurer was fortunate enough to be able to increase the invested capital of the Society by almost exactly £1,500 by the purchase of £1,983 Midland Railway 2½ per cent. Preference Stock for £1,499 14*s*. 5*d*. The income from all sources for the year 1905 exceeds that for 1904 by only £93 8*s*. 4*d*., whilst the expenditure has been abnormally heavy, exceeding the total income by £305 1*s*. 5*d*. This is due to the incidence of several very heavy accounts, one of which really belongs to several years, and that is the completion of the Decennial Index for the period 1893–1902, which has entailed the expenditure this year of no less than £778 10*s*. 5*d*., or rather more than half the total cost. No further expenditure, however, on account of Decennial Indexes will be required for several years to come. As pointed out last year, the continual increase in the cost of the *Journal* and *Proceedings* is a source of much anxiety, and this year a further increase has to be recorded on both accounts, £219 12*s*. 7*d*. in the former and £35 18*s*. 2*d*. in the latter case, or a net increase over the cost of both in 1904 of £255 10*s*. 9*d*., and over that in 1903 of £578 3*s*. 3*d*. The Council therefore trust that authors of papers will do their utmost to assist the Publication Committee and the Treasurer in keeping down the cost of printing as far as possible.

The publication of the *Annual Reports on the Progress of Chemistry* has necessarily added materially to the expenditure of the Society; the cost of Volume I having entailed an expenditure of £445 19*s*. 6*d*., of which about £70 has been recovered by their sale. Another item of some magnitude, £52 9*s*. 6*d*., is the cost of the printing and circulating of the Bye-laws, together with the changes proposed by the Council, which were submitted to an Extraordinary General Meeting of the Society on February 8th, 1905.

The administrative expenses have been carefully kept in check, and whilst everything has been maintained in a state of thorough efficiency their amount is only £827 16*s*. 5*d*., as against £893 1*s*. 0*d*. in 1904.

The following facts with regard to the cost of the Decennial Indexes may be of interest. The total cost of Volume IV, 1893-1902 (Parts I and II), exclusive of distribution amounts to £1,454 5*s.* 6*d.*, of which the cost of printing was £762 6*s.* 0*d.* The cost of Volume III, 1883–1892 (issued in one volume) was £1,280 2*s.* 7*d.*, of which the printing accounted for £585 19*s.* 7*d.* The cost of Volume IV was relatively considerably less than that of Volume III, as the former extended to 45½ sheets for the Authors' Index and 108 sheets for the Subject Index, or 153½ sheets in all, whilst Volume III only contained 102¾ sheets. Owing to the way in which the Annual Indexes are now prepared, it is hoped that when Volume V has to be undertaken, the relative cost will be still further reduced and that the chief cost will be that due to the printing.

BALANCE SHEET.—THE CHEMICAL SOCIETY, 31ST DECEMBER, 1905.

Liabilities.

	£ s. d.	£ s. d.
To Subscriptions received in advance, 1906	207 18 0	
,, ,, ,, ,, 1907	6 0 0	
		213 18 0
,, Cash received on Account of Annual Report for 1905 (not published)		16 19 0
,, Sundry Creditors		1537 12 11
,, Research Fund :—		
As per last Balance Sheet	6784 17 8	
Add Excess of Income over Expenditure for the year	6 1 11	
		6790 19 7
,, Chemical Society :—		
As per last Balance Sheet...	18699 1 6	
Less Excess of Expenditure over Income for the year	305 1 5	
		18394 0 1
		£26953 9 7

Assets.

	£ s. d.	£ s. d.	£ s. d.
By Investments (value when acquired):—			
£1050 London and North Western Railway 3 per cent. Debenture Stock		839 12 0	
£6730 Metropolitan Consolidated 3½ per cent. Stock		7212 8 6	
£1520 14*s.* 3*d.* Cardiff Corporation 3 per cent. Stock		1650 0 0	
£1400 India 2½ per cent. Stock		1316 1 0	
£2400 Bristol Corporation 2½ per cent. Debenture Stock		2070 2 0	
£2358 Midland Railway 2½ per cent. Preference Stock, as per last Balance Sheet	2072 8 0		
£1983 Midland Railway 2½ per cent. Preference Stock, purchased during the year	1499 14 5		
		3572 2	
£1200 Leeds Corporation 3 per cent. Stock		1143 1 0	
£1500 Transvaal 3 per cent. Guaranteed Stock ...		1460 13 6	
			19264 0 5
(Estimated present value of Investments, £18170 15*s.*)			
,, Library, Furniture, Stock of Publications, &c. (not valued)			
,, Sundry Debtors :—			
Society of Public Analysts		11 11 0	
Advertising Agents		50 9 3	
Messrs. Gurney & Jackson		406 18 11	
Telephone Deposit		1 0 0	
			469 19 2
,, Subscriptions in Arrear, £382. Estimated to realise...			250 0 0
,, Insurance paid in advance			30 17 1
,, Cash at Bank		133 13 0	
,, ,, in hand		14 0 4	
			147 13 4
,, Research Fund :—			
Investments (value when acquired):			
£1000 North British 4 per cent. No. 1 Preference Stock		1010 0 0	
£4400 Metropolitan Consolidated 3½ per cent. Stock		4587 18 0	
£1034 Great Western Railway 2½ per cent. Debenture Stock		1049 15 11	
		6647 13 11	
(Estimated present value of Research Fund Investments, £6594 10*s.*)			
Cash at Bank		143 5 8	
			6790 19 7
			£26953 9 7

INCOME AND EXPENDITURE ACCOUNT

Income.

		£ s. d.	£ s. d.
To Life Compositions			360 0 0
,, Admission Fees			592 0 0
,, Annual Subscriptions—			
Received in advance, on account of 1905		255 0 0	
,, during 1905 on account of 1905		3843 0 0	
,, ,, ,, ,, 1904		284 0 0	
,, ,, ,, ,, 1903		4 0 0	
		4386 0 0	
Less amount included in last year's Income, being valuation of Arrears as per last Balance Sheet		330 0 0	
		4056 0 0	
Add Arrears at date: 1905 £352, 1904 £26, 1903 £4, estimated to realise as per Balance Sheet		250 0 0	
			4306 0 0
,, Investments :—			
Dividends on £1,050 London and North Western Railway 3 per cent. Debenture Stock		29 18 6	
£6,730 Metropolitan Consolidated 3½ per cent. Stock ...		223 15 8	
£1,520 14*s.* 3*d.* Cardiff Corporation 3 per cent. Stock ...		43 6 8	
£1,400 India 2½ per cent. Stock		33 5 0	
£2,400 Bristol Corporation 2½ per cent. Debenture Stock		57 0 0	
£4,341 Midland Railway 2½ per cent. Preference Stock		103 2 0	
£1,200 Leeds Corporation 3 per cent. Stock		34 4 0	
£1,500 Transvaal 3 per cent Guaranteed Stock		42 15 0	
Income Tax Recovered		26 6 11	
Interest on Deposit Account		12 1 10	
			605 15 7
,, Publications :—			
Sales :			
Journals		770 3 3	
Proceedings		18 16 9	
General Index		68 5 9	
Memorial Lectures		11 9 6	
Library Catalogue		2 4 9	
Atomic Weight Tables		17 0	
Jubilee Volume		11 0	
Annual Report on the Progress of Chemistry		77 11 0	
		949 19 0	
Less Publishers' Commission		92 9 8	
		857 9 4	
Proceeds of Advertisements in Journal...	£61 15 4		
Less Commission	9 5 3		
		52 10 1	
			909 19 5
,, Subscriptions from other Societies :—			
Society of Chemical Industry		8 8 0	
Society of Public Analysts		11 11 0	
			19 19 0
,, Balance, being Excess of Expenditure over Income carried to Balance Sheet			305 1 5
			£7098 15 5

I have examined the above Accounts with the Books and Vouchers of the Society, and and the Investments.

W. B. KEEN,
Chartered Accountant.

13th March, 1906.

FOR THE YEAR ENDED 31ST DECEMBER, 1905.

Expenditure.

	£	*s.*	*d.*	£	*s.*	*d.*
By Expenses on account of Journal and Proceedings :—						
Salary of Editor ...	300	0	0			
Salary of Sub-Editor ...	200	0	0			
Salary of Assistant Sub-Editor ...	51	5	0			
Salary of Indexer ...	80	0	0			
Editorial Postages, &c. ...	23	4	1			
Abstractors' Fees ...	431	13	6			
Printing of Journal ...	2313	4	11			
Printing of Advertisements ...	28	12	0			
Printing of Wrappers ...	115	16	6			
Distribution of Journal ...	491	13	9			
Authors' Copies ...	113	9	6			
Illustrations ...	22	9	5			
Insurance of Stock at Clay's ...	10	13	6			
				4182	2	2
Printing of Proceedings ...	207	7	6			
Distribution of Proceedings ...	44	4	10			
				251	12	4
,, Annual Report on the Progress of Chemistry ...				445	19	6
,, List of Fellows ...				74	0	1
,, Printing and Distribution of Bye-Laws ...				52	9	6
,, Collective Index :—						
Printing Vol. IV., Part II ...	592	9	6			
Distribution ...	38	10	9			
Salaries ...	147	10	2			
				778	10	5
,, Library Expenses :—						
Salary of Librarian ...	105	0	0			
Books and Periodicals ...	232	11	10			
Binding ...	63	8	0			
				400	19	10
,, Indexing for International Catalogue ...				30	0	0
,, Balance of Dinner Account ...				55	5	2
,, Administrative Expenses :—						
Tea Expenses ...	31	5	4			
Salary of Assistant Secretary ...	170	0	0			
Salary of Office Assistant...	28	11	6			
Wages (Commissionaire, Housekeeper, and Charwoman) ...	148	2	0			
Pension, Mrs. Hall ...	30	0	0			
Coal and Lighting ...	43	13	10			
House Expenses and Repairs ...	90	11	0			
Insurance ...	6	17	2			
Accountants' Charges ...	10	10	0			
Accountants' Commission on Recovery of Income Tax...	1	16	9			
Legal Charges ...	21	5	0			
Miscellaneous Printing ...	83	17	0			
Stationery ...	37	17	9			
Furniture ...	5	8	7			
Postages ...	89	7	5			
Miscellaneous Expenses ...	28	13	1			
				827	16	5
				£7098	15	5

certify them to be in accordance therewith. I have also verified the Balance at the Bankers

Approved— E. GRANT HOOPER,
HY. FORSTER MORLEY,
H. R. LE SUEUR.

RESEARCH FUND INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER, 1905.

Income.

	£	s.	d.	£	s.	d.
To Dividends :—						
On £1000 North British Railway 4 per cent. No. 1 Preference Stock	38	0	0			
On £4400 Metropolitan Consolidated 3½ per cent. Stock	146	6	0			
On £1034 Great Western Railway 2½ per cent. Debenture Stock	24	11	2			
				208	17	2
,, Repayments of Research Grants :—						
G. Dean	1	5	5			
G. Young..	1	0	0			
J. C. Cain	7	14	1			
B. D. Steele	9	15	7			
Miss I. Smedley	3	0	2			
				22	15	3
,, Income Tax Recovered				10	9	6
				£242	1	11

Expenditure.

	£	s.	d.	£	s.	d.
By Grants to—						
W. C. Ball	5	0	0			
E. C. C. Baly	15	0	0			
F. E. Francis	10	0	0			
J. A. N. Friend	3	0	0			
P. Haas	3	0	0			
T. M. Lowry	10	0	0			
R. S. Morrell	10	0	0			
R. H. Pickard...........................	15	0	0			
A. W. Stewart	5	0	0			
J. J. Sudborough	20	0	0			
J. F. Thorpe	15	0	0			
A. E. H. Tutton	20	0	0			
E. F. Armstrong	10	0	0			
J. B. Cohen..	5	0	0			
A. Findlay	5	0	0			
A. G. Green	10	0	0			
J. Hawthorne....................................	5	0	0			
F. W. Kay	10	0	0			
A. McKenzie	10	0	0			
T. S. Moore........	5	0	0			
R. Robinson	10	0	0			
S. Ruhemann	15	0	0			
Miss A. E. Smith	5	0	0			
A. Tattersall	10	0	0			
J. A. Gardner..	5	0	0			
				236	0	0
,, Balance, being excess of Income over Expenditure, carried to Balance Sheet				6	1	11
				£242	1	11

I have examined the above Account with the Books and Vouchers of the Society, and certify it to be in accordance therewith. I have also verified the Balance at the Bankers and the Investments.

W. B. KEEN,
Chartered Accountant.

13th March, 1906

Approved—
E. GRANT HOOPER,
HY. FORSTER MORLEY,
H. R. LE SUEUR.

LIST

OF THE

OFFICERS AND FELLOWS

OF THE

CHEMICAL SOCIETY.

CORRECTED TO OCTOBER, 1905.

BURLINGTON HOUSE,
LONDON, W.
1905.

OFFICERS AND COUNCIL,

ELECTED MARCH 29th, 1905.

PRESIDENT.

RAPHAEL MELDOLA, F.R.S.

VICE-PRESIDENTS

WHO HAVE FILLED THE OFFICE OF PRESIDENT.

HENRY EDWARD ARMSTRONG, PH.D., LL.D., F.R.S.
ALEXANDER CRUM BROWN, D.Sc., LL.D., F.R.S.
SIR WILLIAM CROOKES, D.Sc., F.R.S.
SIR JAMES DEWAR, M.A., LL.D., F.R.S.
AUGUSTUS GEORGE VERNON HARCOURT, M.A., D.C.L., F.R.S.
HUGO MÜLLER, PH.D., LL.D., F.R.S.
WILLIAM ODLING, M.A., M.B., F.R.S.
WILLIAM HENRY PERKIN, PH.D., LL.D., F.R.S.
JAMES EMERSON REYNOLDS, Sc.D., M.D., F.R.S.
SIR HENRY ENFIELD ROSCOE, LL.D., F.R.S.
WILLIAM JAMES RUSSELL, PH.D., F.R.S.
THOMAS EDWARD THORPE, C.B., LL.D., F.R.S.
WILLIAM AUGUSTUS TILDEN, D.Sc., F.R.S.

VICE-PRESIDENTS.

HORACE TABBERER BROWN, LL.D., F.R.S.
HAROLD BAILY DIXON, M.A., F.R.S.
WYNDHAM ROWLAND DUNSTAN, M.A., LL.D., F.R.S
DAVID HOWARD.
ARTHUR SMITHELLS, B.Sc., F.R.S.
WILLIAM PALMER WYNNE, D.Sc., F.R.S.

SECRETARIES.

MARTIN ONSLOW FORSTER, D.Sc., PH.D., F.R.S.
ARTHUR WILLIAM CROSSLEY, D.Sc., PH.D.

FOREIGN SECRETARY.

SIR WILLIAM RAMSAY, K.C.B., LL.D., F.R.S.

TREASURER.

ALEXANDER SCOTT, M.A., D.Sc., F.R.S.

OTHER MEMBERS OF COUNCIL.

EDWARD CHARLES CYRIL BALY.
AUGUSTUS EDWARD DIXON, M.D.
JAMES JOHNSTON DOBBIE, M.A., D.Sc., F.R.S.
BERNARD DYER, D.Sc.
ALFRED DANIEL HALL, M.A.
ARTHUR LAPWORTH, D.Sc.
JAMES ERNEST MARSH, M.A.
EDMUND JAMES MILLS, D.Sc., F.R.S.
GERALD TATTERSALL MOODY, D.Sc.
WILLIAM JAMES SELL, M.A., F.R.S.
JOHN MILLAR THOMSON, LL.D., F.R.S.
JOHN WADE, D.Sc.

EDITOR OF THE SOCIETY'S JOURNAL.

GILBERT THOMAS MORGAN, D.Sc.

SUB-EDITOR OF THE SOCIETY'S JOURNAL.

ALFRED JOHN GREENAWAY.

ASSISTANT SUB-EDITOR.

CECIL HENRY DESCH, D.Sc., PH.D.

ASSISTANT SECRETARY.

STANLEY ERNEST CARR.

LIBRARIAN.

FRANCIS WILLIAM CLIFFORD.

COMMITTEES, 1905–6.

Professor R. Meldola (President), Dr. A. Scott (Treasurer), Dr. M. O. Forster and Prof. A. W. Crossley (Hon. Secretaries), and Sir William Ramsay (Foreign Secretary), are *ex officio* members of each Committee.

HOUSE COMMITTEE.

Messrs. Horace T. Brown, Wyndham R. Dunstan, W. J. Russell, J. Millar Thomson, T. E. Thorpe, William A. Tilden, and the Officers.

LIBRARY COMMITTEE.

Messrs. Bennett H. Brough, Frederick D. Chattaway, J. Norman Collie, Bernard Dyer, Arthur Harden, Charles A. Keane, E. J. Mills, G. T. Morgan, Hugo Müller, J. Millar Thomson (Chairman), J. A. Voelcker, and the Officers.

PUBLICATION COMMITTEE.

Messrs. Horace T. Brown, Wyndham R. Dunstan, Bernard Dyer, H. McLeod, E. J. Mills, William A. Tilden, and the Officers.

RESEARCH FUND COMMITTEE.

Messrs. Horace T. Brown, Wyndham R. Dunstan, Percy F. Frankland, G. Matthey, H. Müller, W. H. Perkin, Jun., S. P. U. Pickering, William A. Tilden, M. W. Travers, W. P. Wynne, and the Officers.

The Ordinary Scientific Meetings for 1905-6 will be held on the following Thursdays at 8.30 p.m. :—

November 2nd, 1905
,, 16th, ,,
December 7th, ,,
,, 21st, ,,
January 18th, 1906
February 1st, ,,
,, 15th, ,,

March 1st, 1906
,, 15th, ,,
April 5th, ,,
May 3rd, ,,
,, 17th, ,,
June 7th, ,,
,, 21st, ,,

Annual General Meeting, Friday, March 30th, 1906, at 5 p.m.

Society's Bankers:

Messrs. COUTTS & CO., 440, Strand, W.C.

Telephone No.: 1368, Mayfair.

THE CHEMICAL SOCIETY.

The Chemical Society was founded on February 23rd, 1841, and its first General Meeting was held on March 30th of that year. In 1848, a Charter of Incorporation was granted to the Society by the Crown, under the conditions of which it consists of Fellows, Honorary and Foreign Members, and Associates.* The Fellows elect out of their own body a Council consisting of a President, Vice-Presidents, a Treasurer, two Secretaries, a Foreign Secretary, and twelve other Fellows, by whom the business of the Society is conducted.

The object of the Society, as laid down in the Charter, is the general advancement of Chemical Science, by the discussion and publication of new discoveries, and the interchange of valuable information respecting them.

A Candidate for election as a Fellow of the Chemical Society must send to the Secretaries a Certificate subscribed by not less than five Fellows of the Society, to three at least of whom he must be personally known.† The Certificate will be read at three Ordinary Meetings of the Society, and the Candidate will afterwards be balloted for. When elected, he will receive notice of the same from the Secretaries.

Each Fellow has the right to be present and to vote at all Meetings of the Society, and to propose Candidates for admission into the Society, and is entitled to one copy of the Annual Publications so long as his Annual Subscription be not in arrear. He is also entitled to the use of the books in the Society's Library, under such restrictions as the Council may deem necessary. He has the privilege of introducing two visitors to Ordinary Meetings of the Society, whose names are entered in a book kept for that purpose, together with the name of the Fellow introducing such visitors.

When elected, every Candidate previous to admission is required, within three months from the date of his election, to pay an admission fee of £4, and either his first annual subscription, or his life composition fee; otherwise his election becomes void. The annual subscription to be paid by Fellows is £2. The subscriptions of Fellows become due on the first day of January of every year. The life composition fee is £30, excepting that Fellows who have paid ten annual subscriptions pay as life composition fee £20 ; Fellows who have paid fifteen annual subscriptions pay £15; Fellows who have paid twenty annual subscriptions pay £12; and Fellows who have paid twenty-five annual subscriptions pay £10.

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* No elections of Associates have taken place for many years.

† In the case of Candidates resident abroad unable to obtain this number of signatures, the Council have power to accept a certificate signed from personal knowledge by one Fellow of the Society, and to recommend its presentation for ballot.

If, however, a Candidate be elected during the month of November or December, he will not be called upon to pay any annual subscription for the current year, and will not be entitled to receive the publications of the Society for that year.

Any Fellow who at the period of the Annual General Meeting of the Society in March shall owe two annual subscriptions, such subscriptions having been duly applied for, and no reason satisfactory to the President and Council having been assigned for their non-payment, ceases to be a Fellow of the Society, and his name will be removed from the Society's List accordingly : Provided, nevertheless, that on a solicitation for re-admission being addressed to the President and Council by a person so circumstanced, the case of such person will be considered by the Council, who may, if they see fit, reinstate him as a Fellow of the Society, upon his paying the arrears of his subscription, or a life composition fee.

PUBLICATIONS OF THE SOCIETY.

The following is a list of the Publications of the Society :

	Price per Vol. to Fellows.			Price per Vol. to Public.		
	£	*s.*	*d.*	£	*s.*	*d.*
Memoirs and Proceedings, 1841-1847 (3 Vols.)	1	0	0	1	10	0
†Quarterly Journal, 1848-62 (14 Vols.)	1	0	0	1	10	0
†Journal, 1862—present date, 1862-1895	1	10	0	1	10	0
do. do.	2	0	0	2	0	0
†Proceedings, 1885—present date		7	6		7	6
Annual Reports on the Progress of Chemistry, Vol. I., 1904 (bound in cloth)		4	6		4	6
Collective Index, Vol. I. 1841-1872		4	0		4	0
* do. Vol. II. 1873-1882		10	0		15	0
* do. Vol. III. 1883-1892		15	0	1	0	0
* do. Vol. IV. 1893-1902	1	0	0	1	10	0
Jubilee Volume, 1891		6	0		6	0
Memorial Lectures, 1893-1900		7	6		7	6
Library Catalogue, 1886		1	0		1	0
do. 1903		2	6		2	6
Tables of International Atomic Weights (as recommended by the International Atomic Weights Com.)	1/6 per doz. ; 12/- per hundred.					

† The Society cannot supply complete sets of these.

* Postage 1s. extra.

The *Journal*, which is issued monthly, contains papers communicated to the Society, Memorial Lectures on the life and work of eminent Fellows deceased, together with abstracts of all papers relating to chemistry and closely connected branches of science published in other journals, British and foreign.

The *Proceedings* contains a short report of the business at each meeting, and abstracts of all papers presented to the Society. It is usually published about seven days after the meeting. It serves as a medium of publication, not only for the abstracts of papers which subsequently appear in full in the Journal, but also for short papers and preliminary communications.

The Annual Reports on the Progress of Chemistry give an epitome of the principal definite steps made in the advancement of Chemistry during the year.

COMMUNICATION OF PAPERS.

All communications for the Journal and for the Proceedings of the Society should be addressed to "The Secretaries, Chemical Society, Burlington House, W."

The Council have decided that no communication shall be included in the list of titles of papers to be brought before a Meeting of the Society, unless it is in the hands of the Secretaries at least three days before the date of the Meeting. No announcement of titles can be made in the Proceedings until the communications have been received by the Secretaries. Papers which, on the report of referees, are deemed by the Council unsuitable for publication in the Transactions, are deposited in the Society's Archives. In all cases, an abstract of the paper, not exceeding three hundred words in length, should be supplied for insertion in the Proceedings.

Communications which have already appeared in any foreign journal will not be published in the Society's Transactions, unless this course is specially recommended by the Publication Committee and this recommendation approved by the Council.

RESEARCH FUND.

The Research Fund of the Chemical Society has been established for the purpose of assisting investigators by defraying the cost of expensive materials. The Committee meets twice a year to consider applications for grants, and forms of application, duly filled up, must be lodged with the Secretaries before the end of May and November in each year.

NAMES OF HONORARY AND FOREIGN MEMBERS.

NUMBER NOT TO EXCEED FORTY.

Date of Election.	
Jan. 20, 1898	Arrhenius, Prof. Dr. Svant August, Bergsgaten 18, Stockholm
May 18, 1876	Baeyer, Geh. Rath, Prof. Dr. Adolph von, F.R.S., Arcis-str. 1, Munich
May 18, 1904	Becquerel, Prof. Antoine Henri, 6, Rue Dumont d'Urville, XVI., Paris
Feb. 1, 1883	Beilstein, Prof. Dr. Fedor, W.O., 8th line, No. 17, St Petersburg
Mar. 1, 1860	Berthelot, Prof. Marcellin, Membre de l'Institut, F.R.S., Collège de France, Paris
Feb. 2, 1888	Boisbaudran, Lecoq de, Rue de Longchamp 113, Passy, Paris
June 19, 1862	*Cannizzaro, Prof. Stanislao, F.R.S., Reale Università, Rome
May 18, 1904	Clarke, Prof. Frank Wigglesworth, United States Geological Survey, Washington, D.C., U.S.A.
May 18, 1904	Curie, Madame Marie, La Sorbonne, Paris
Jan. 20, 1898	Curtius, Geh. Rath, Prof. Dr. Theodor, Universität, Heidelberg
Feb. 1, 1883	Erlenmeyer, Prof. Dr. Emil, Aschaffenburg, Germany
June 16, 1892	Fischer, Geh. Rath, Prof. Dr. Emil, F.R.S., Dorotheenstr. 10, Berlin
Feb. 1, 1883	Fittig, Prof. Dr. Rudolph, Universität, Strassburg
Jan. 20, 1898	Franchimont, Prof. Dr. Antoine Paul Nicolas, Rapenburg 104, Leyden
May 3, 1866	Gibbs, Prof. Wolcott, M.D., Newport, Rhode Island, U.S.A.
June 16, 1892	Graebe, Prof. Dr. Carl, Université, Geneva
Feb. 2, 1888	Hoff, Prof. Dr. Jacobus Henricus van't, F.R.S., Lietzenburgerstrasse 54, Berlin, 15, W.
Jan. 20, 1898	Körner, Prof. Wilhelm, R. Scuola superiore d'agricoltura, Milan
Feb. 2, 1888	Ladenburg, Geh. Reg.-Rath, Prof. Dr. Albert, Kaiser Wilhelmstrasse 43, Breslau
Feb. 2, 1888	Landolt, Prof. Dr. Hans, Albrechtstrasse 14, Berlin, N.W.
June 16, 1892	Lieben, Prof. Dr. Adolph, Wasagasse 9, Vienna
May 18, 1904	Liebermann, Geh. Rath, Prof. Dr. Carl, Matthäikirchstrasse 29, Berlin, W.
Feb. 1, 1883	†Mendeléeff, Prof. Dr. Dmitri Ivanovitsch, F.R.S., 19, Zabalkansky, St. Petersburg

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* Faraday Lecturer, 1872.

† Faraday Lecturer, 1889.

Date of Election.	
Jan. 20, 1898	Menschutkin, Prof. Dr. Nicolai, Sosnovka, Polytechnikum, St. Petersburg
Jan. 20, 1898	Moissan, Prof. Henri, Rue Vauquelin 7, Paris
May 18, 1904	Morley, Prof. Edward Williams, Adelbert College, Cleveland, Ohio, U.S.A.
Jan. 20, 1898	Ostwald, Prof. Dr. Wilhelm, Linnéstrasse 2/3, Leipzig
Jan. 20, 1898	Remsen, Prof. Ira, Johns Hopkins University, Baltimore, U.S.A.
June 16, 1892	Schiff, Prof. Dr. Hugo, Via Gino Capponi 3, Florence
June 16, 1892	Schlœsing, Prof. Dr. Théophile, Institut Agronomique, Paris
Jan. 20, 1898	Spring, Prof. Walthère, Rue Beckmann 32, Liége
May 18, 1876	Thomsen, Prof. Dr. Julius, F.R.S., Lindevei 13, Copenhagen
Jan. 20, 1898	Troost, Prof. Louis Joseph, Rue Bonaparte 84, Paris
Jan. 20, 1898	Waals, Prof. Dr. Johannes Diderik van der, T.C., Hooftstraat 117, Amsterdam

* Faraday Lecturer, 1904.

FARADAY LECTURERS.

1869. Jean Baptiste André Dumas.
1872. Stanislao Cannizzaro.
1875. August Wilhelm von Hofmann.
1879. Charles Adolphe Wurtz.
1881. Hermann Ludwig Ferdinand von Helmholtz.
1889. Dmitri Ivanovitsch Mendeléeff.
1895. Lord Rayleigh.
1904. Wilhelm Ostwald.

LONGSTAFF MEDALLISTS.

1881. Thomas Edward Thorpe.
1884. Cornelius O'Sullivan.
1888. William Henry Perkin.
1891. Francis Robert Japp.
1894. Horace Tabberer Brown.
1897. William Ramsay.
1900. William Henry Perkin, junr.
1903. William Jackson Pope.

Any inaccuracies in this list should be reported to The Secretaries, Chemical Society, Burlington House, W.

NAMES OF FELLOWS.

‖ Denotes Life Members.
Trans. Denotes Members who have contributed Papers published in the Society's Transactions.
Proc. ,, ,, ,, ,, ,, ,, ,, ,, Proceedings.
C. ,, ,, ,, served on Council of the Society; V.P. as Vice-President;
S. as Secretary; T. as Treasurer; F.S. as Foreign Secretary; P. as President.

Date of Election.			
1904	Trans.		Abell, Robert Duncombe, D.Sc. (Wales), Ph.D. (Leipzig), F.I.C., University College of South Wales and Monmouthshire, Cardiff
1871	Trans.	C. 1882-4	Abney, Sir William de Wiveleslie, K.C.B., Hon. D.C.L. (Dun.), Hon. D.Sc. (Vict.), Sc.D. (Dub.), F.R.S., F.R.A.S., F.R.G.S., F.I.C., Rathmore Lodge, Bolton-gardens-south, S.W.
1883			Abraham, Alfred Clay, F.I.C., 87, Bold-street, Liverpool
1890			‖Abrines, Gustavus Anthony, Sanitary Commissioner's Office, Gibraltar
1904			Ackroyd, John Prest, B.Sc. (Lond.), 116, Richmond-street, Accrington, Lancs.
1875	Trans.		Acworth, Joseph John, Ph.D. (Erlangen), F.I.C., Thornbank, Shootup-hill, Brondesbury, N.W.
1892			Adams, Arthur, F.I.C., Kelvin House, Edgbaston-road, Smethwick
1888			Adams, Charles M., Albany-buildings, Lord-street, Southport
1877	Trans.		‖Adams, Matthew Algernon, F.R.C.S. (Eng.), F.I.C., The Kulm, Bearsted, near Maidstone
1901			Adams, Ormsby Gore, School of Mines, Thames, Auckland, New Zealand
1892			Adcock, Samuel Robert, The St. Helens Smelting Co., Atlas-court, St. Helen's, Lancs.
1896			Addie, Robert, Messrs. Kennedy and Addie, Norfolk House, Laurence Pountney Hill, E.C.
1881	Trans.		Adeney, Walter Ernest, D.Sc. (R.U.I.), A.R.C.S.I., F.I.C., Royal University of Ireland, Earlsfort-terrace, Dublin
1885	Trans.		Adie, Richard Haliburton, B.Sc. (Lond.), M.A. (Cantab), 136, Huntingdon-road, Cambridge
1885			Adriance, John Sabine, Ph.D., 105, East Thirty-ninth-street, New York, U.S.A.
1901			Aitken, Andrew Charles, c/o The Burma Oil Co., Ltd., Rangoon, Burma
1879			Albright, George Stacey, Bromesberrow-place, Ledbury

Date of Election.		
1893		Albuquerque, John Pedrozo d', Prof., M.A. (Cantab.), F.I.C., Government Laboratory, Barbados, West Indies
1885		Alcock, Frank Harris, F.I.C., 9, Broad-street Corner, Birmingham
1892		Alcock, John W., Central Brewery, 45, Mott-street, Birmingham
1902		Alder, John Frederick, 28, Claverly-grove, Church End, Finchley, N.
1903		Alderton, Gilbert John, B.Sc. (Lond.), A.I.C., "The Nest," Eglington-road, Plumstead, Kent
1888	Proc.	Alexander, John, M.A. (Glas.), Midfield, Perth
1886		Allan, James Henry, 45, Walton-vale, Liverpool
1893		Allan, John, 55, Northern-grove, West Didsbury, near Manchester
1894		Allen, Frederick John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1901		Allen, Frederick Thomas, B.Sc. (Dun.), 32, Currock Terrace, Carlisle
1870		Allen, John, Phœnix Chemical Works, Upper North-street, Poplar, E.
1905		Allen, William Harold Richard, c/o Straits Trading Co., Butterworth, Penang, Straits Settlements
1894		Allibon, George H., 19, Short-strand, Belfast
1899		Allworthy, James Herbert, Sir Roger Manwood's School, Sandwich, Kent
1899		‖Allworthy, Samuel William, M.A., M.D., B.Ch. (Dub.), The Manor House, Antrim-road, Belfast
1903		Alton, William Lester St. John, A.I.C., "Dungarvan," Putney Heath, S.W.
1905		Amos, Arthur, B.A. (Cantab.), Spring-grove, Wye, Kent
1885	Proc.	‖Amphlett, Edward Greenhill, M.A. (Oxon.), 3, Union-place, Worthing
1890		Anderson, Frederic Alfred, B.Sc. (Lond.), F.I.C., 31a, Clanricarde-gardens, W.
1895		Anderson, Herbert, Royal Latin School, Buckingham
1900		Anderson, James William, The Paddock, Halling, near Rochester
1901	Trans.	Anderson, William Carrick, M.A., D.Sc. (Glas.), 8, Windsor Quadrant, Kelvinside, Glasgow
1892		Anderson, William Smellie, Christmas Island, c/o Messrs. Boustead & Co., Singapore, Straits Settlements
1905		Andrews, Albert Edward, 37, Oakhurst-grove, East Dulwich, S.E.
1888		Andrews, Edward Arthur, St. Mary's Hospital, Paddington, W.
1882		Andrews, Launcelot W., Ph.D., The University, Iowa City, Iowa, U.S.A.
1870		Andrews, Thomas, F.R.S., M.I.C.E., Ravencrag, Wortley, near Sheffield

Date of Election			
1905	Trans.		Angel, Andrea, M.A. (Oxon.), 41, Wellington-square, Oxford
1877			Angell, John, F.I.C.,6, Beacon's-field, Derby-road, Withington, Manchester
1898	Trans.		Annable, Henry William Coupe-, Tungsten and Rare Metals Co., Ltd., Queen's-road, Battersea, S.W.
1879			Appleby, Herbert, 2, John Dalton-street, Manchester
1903			Appleyard, George Henry, F.I.C., Wilmington Oil Mills, 151, Cleveland-street, Hull
1890	Trans.		Appleyard, James Robert, Royal Technical Institute, Salford
1904			‖Appleyard, Percy, Albany, Western Australia
1884			Archbutt, Leonard, F.I.C., The Yews, Madeley-street, Derby
1875			Armistead, William, M.B., C.M. (Edin.), Stapleford, Cambridge
1900	Proc.		Armitage, Francis Paul, Colet House, Talgarth-road, West Kensington, W.
1903	Trans.		‖Armstrong, Edward Frankland, Ph.D. (Berlin), D.Sc. (Lond.), 55, Granville-park, Lewisham, S.E.
1900			Armstrong, Frederick William, 6, St. Thomas's-terrace, Wells, Somerset
1870	Trans.	C.1873-5 S. 1875-93 P.1893-5	‖Armstrong, Henry Edward, Prof., LL.D. (St. Andrews), Ph.D. (Lips.), F.R.S., 55, Granville-park, Lewisham, S.E., and Central Technical College, Exhibition-road, S.W.
1905			Arnaud, Francis William Frederick, F.I.C., 17, Maddox-street, W.
1894			Ashdown, Charles Henry, F.R.G.S., Monastery-close, St. Albans
1903			Ashdown, Herbert Henry, 3, Genesta-road, Plumstead, Kent
1902			Ashe, James Samuel, 77, Moyne-road, Rathmines, Dublin
1900			Ashton, James, Hacken Sewage Works, Moses Gate, Bolton
1905			Ashwell, James Henry, 117, Waterloo-crescent, Nottingham
1897			Ashworth, John B., Bridge Cottage, Broad-green, Liverpool
1901	Trans.		Aspinall, Thomas, 42, Gilnow-road, Bolton
1900			Aston, Bernard Cracroft, N.Z. Agricultural Dept., Wellington, New Zealand
1901	Trans.		Aston, William George, 12, Douglas-road, Goodmayes, Ilford, E.
1903			Atkinson, Edwin Bayles, Furze Glen, Lambert-road, Grimsby
1899			Atkinson, George Dekeyne, c/o Messrs. Alton & Co., Ltd. Wardwick Brewery, Derby
1903			Atkinson, Harford Montgomery, B.Sc. (Wales), Ph.D. (Göttingen), 7, College-gardens, Belfast
1872	Trans.		‖Atkinson, Robert William, B.Sc. (Lond.), F.I.C., 44, Stuart-street, Cardiff
1862	Trans.	C. 1874-8	‖Attfield, John, Prof., M.A., Ph.D. (Tübingen), F.R.S., F.I.C., Ashlands, Watford, Herts.
1904	Trans.		Attwell, Herbert Moore, A.R.C.S., Beckhythe, Overstrand, Cromer

Date of Election.		
1872	Trans.	‖Attwood, George, F.G.S., M.I.C.E., Durmast Lodge, Ringwood, Hants, and Mansion House Chambers, 13, Sise-lane, Queen Victoria-street, E.C.
1903		Aubrey, Henry James, The Cross, Worcester
1895	Trans.	‖Auden, Harold Allden, Central Laboratory, United Alkali Co., Widnes, Lancs.
1886		Audley, James Aloysius, B.Sc. (Lond.), A.R.C.S., F.I.C., c/o Messrs. G. Howson and Sons, Eastwood Sanitary Works, Hanley, Staffs.
1877		Austen, Peter Townsend, Ph.D., 204, West 86th-street, New York, U.S.A.
1892		Avery, David, Working Men's College, Melbourne, Australia
1896		Aykroyd, Henry Edward, Ashdown, Apperley Bridge, near Bradford
1891		Aylan, John Charles, Manager Royal Laboratory, Royal Arsenal, Woolwich, S.E.
1904		‖Badcock, William Cornish, M.A. (Cantab.), The Grammar School, Crediton, Devon
1904		Bagnley, Allan, B.Sc. (Wales), F.I.C., University College of North Wales, Bangor
1875	Trans.	‖Bailey, George Herbert, Ph.D., D.Sc. (Lond.), The University, Manchester, and Marple Cottage, Marple, Cheshire
1895		Bailey, George Percy, M.A. (Dub.), Victoria Institute, Worcester
1903		Bailey, Harold James, Maritime Coke Works, Pontypridd, S. Wales
1893		Bailey, Henry, 18, Lavender-sweep, S.W.
1898		Bailey, William Martin, M.A. (Dub.), Penrhyn, Ty'rfran, Llanelly
1900		Bain, Alexander William, B.A., B.Sc. (Lond.), A.I.C., 2, Muswell Rise, Muswell Hill, N.
1884		‖Bain, Daniel, United Alkali Co., Ltd., Allhusen's Works, Gateshead-on-Tyne
1891		Bairstow, John, Burley, Queen's-park, Chester
1901		Baker, Arthur, 90, Blackbun-road, Darwen, Lancs.
1889		‖Baker, Charles Frederic, B.Sc. (Lond.), Ph.D., Technical College, Sunderland
1883	Trans.	‖Baker, Charles John, The Schools, Shrewsbury
1899		Baker, Clement Harrison, 70, Blenheim-road, Moseley
1902		Baker, Frederick Guy Stirling, Marryatt's Lodge, Snaresbrook, Essex
1900		Baker, Frederick Nolan, Lieut., Ripley Lodge, Belvedere, Kent

Date of Election.			
1881	Trans.		Baker, Harry, F.I.C., Epworth House, Moughland-lane, Runcorn, Cheshire
1884	Trans.	C. 1899-03	‖Baker, Herbert Brereton, M.A. (Oxon.), F.R.S., Christ Church, Oxford
1893	Trans.		Baker, Julian Levett, F.I.C., Stainesbury Holt, Kingston-road, Staines
1901			Baker, Thomas Thorne, 16, Rutland Park Mansions, Willesden Green, N.W.
1873			Baldock, John Henry, Overdale, St. Leonard's-road, Croydon
1902			Ball, James Handby, M.Sc. (L'pool), A.I.C., Rathbane Cottage, Limerick, Ireland
1897	Trans.		Ball, John, Ph.D. (Zürich), F.G.S., A.M.I.C.E., Geological Survey Office, Public Works Department, Cairo, Egypt
1897			Ball, William, Carnfield, Westcote's Drive, Leicester
1901	Trans.		Ball, Walter Craven, B.A. (Oxon.), Guy's Hospital, S.E.
1892			‖Ballantyne, Horatio, F.I.C., 75, Chancery-lane, W.C.
1896		C. 1905-	Ballingall, William, Ardarrock, Dundee
1891	Trans.		Baly, Edward Charles Cyril, F.I.C., University College, Gower-street, W.C.
1886			Bamber, Henry Kelway George, Ingress House, Greenhithe, Kent
1890	Proc.		Bamber, Montague Kelway, F.I.C., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1896			Banerjee, Gopal Chandra, Kaiser Soap Co., Cawnpore, India
1888			Banner, Samuel, Sherwood, Sefton-park, Liverpool
1871			‖Bannister, Richard, F.I.C., 59, Tregunter-road, S. Kensington, S.W.
1904	Trans.		Barbour, William, M.A., B.Sc. (St. Andrew's), Technical School, Peterborough
1880			Barclay, Arthur Edward, 95, Farringdon-street, E.C.
1903	Trans.		‖Barger, George, M.A. (Cantab.), D.Sc. (Lond.), The Wellcome Physiological Research Laboratories, Brockwell Hall, Herne Hill, S.E.
1903			Barker, Thomas Vipond, Exeter College, Oxford
1896			Barker, William Henry, B.Sc. (Lond.), Addiscombe, Empress-avenue, Wanstead Park, Essex
1870			Barklie, Robert, Faunmore, Strandtown, Belfast
1894			Barlet, Stéphane, B.Sc. (Univ. Gall.), 47, Bassett-road, N. Kensington, W.
1897			Barlow, Herbert William Leyland, M.A., M.D. (Oxon.), Holly Bank, Croftsbank-road, Urmston, Manchester
1897			Barlow, William, The Red House, Stanmore, Middlesex
1891			Barnes, Edward Arthur, 194, Hammersmith-road, W., and Dynamite Works, Modderfontein, near Zuurfontein, S. Africa
1905			Barnes, James Hector, B.Sc. (Birm.), A.I.C., County Chemical Laboratory, Shirehall, Worcester

Date of Election.			
1875			‖Barnes, Richard Leburn, Phœnix Chemical Works, Hackne Wick, N.E.
1888			‖Barraclough, William Herbert, F.I.C., Mortomley, near Sheffiel
1895			Barralet, Edgar S., 6, Wellington-mansions, Queen's Club gardens, W.
1891			Barratt, J. Treeby, Bronheulog, Mostyn, North Wales
1869			Barret, Edward Louis, B.Sc. (Lond.), F.I.C., 12, Avenue de l Grande Armée, Paris
1901			Barrie, Thomas Stewart, 157, St. Vincent-street, Glasgow
1872			‖Barton, Robert, Royal Mint, Melbourne, Australia
1883			Basker, John Anthony, Fore-street, Bridgwater
1898			Baskerville, Charles, B.Sc. (Va.), Ph.D. (N. Carolina), Colleg of the City of New York, New York, U.S.A.
1864	Trans.	C. 1870-3, 90-3	‖Bassett, Henry, F.I.C., 26, Belitha-villas, Barnsbury, N.
1891			Bate, William, National Explosives Co., Hayle, Cornwall
1893			Bateman, John, c/o Messrs. J. C. and J. Field, The Marsh Lambeth, S.E.
1896			Bathurst, Charles, jun., B.A. (Oxon.), 3, Stone-buildings Lincoln's Inn, W.C.
1905			‖Baxter, John George, Court Sole, Cliffe, near Rochester
1896			Bay, Lauritz Hansen, B.Sc. (Lond.), Deacon's School, Pete borough
1892			Bayliss, Charles, "Mino," Castle Bromwich, near Birmingham
1874			Bayly, F. W., The Royal Mint, Sydney, N.S.W.
1904			Bayly, Harold Goodenough, F.I.C., Moatside, Bedford
1874			‖Bayne, James, F.I.C., 31, Vaughan Terrace, Harrow
1879			‖Bayne, William Thirlwall, LL.D., Brockhill, Broad Clyst, Exet
1897			Beadle, Alec Alfred, Greenheys, Granville-road, High Barnet
1891	Trans.		Beadle, Clayton, Melrose, Hatherley-crescent, Sidcup
1861			‖Beadnell, Charles Edward, Major, R.A., Llandinam, Mon gomeryshire, R.S.O.
1904			Beadnell, Charles Marsh, M.R.C.S. (Eng.), L.R.C.P. (Lond. Fleet Surgeon, H.M.S. *New Zealand*, Atlantic Squadro Gibraltar
1867			Beale, William Phipson, K.C., 10, New-court, Carey-stree Lincoln's Inn, W.C. ; and 25, Sheffield-terrace, Kensington, W
1905			Bealey, Edward Williams, B.A. (Cantab.), 55, Belsize-park gardens, Hampstead, N.W.
1904			Beam, William, M.A., M.D. (Penn.), F.I.C., Chemical Laboratory, Gordon College, Khartoum, Soudan
1899			Bean, Percy, 17, Dickinson-street, Manchester
1903			Beanes, Alfred Edward, Falcon Works, Wallis-road, Hackne Wick, N.E.

Date of Election.			
1864			‖Beanes, Edward, Moatlands, Paddock Wood, Kent
1890			Beardmore, George Russell, D.P.H. (Cantab.), L.R.C.P. (Lond.), M.R.C.S. (Eng.), L.S.A., Warwick House, Upper-street, Islington, N.
1887			Beasley, William Charles Trevor, M.A. (Cantab.), 10, Stockleigh-road, St. Leonards-on-Sea
1901			Beaven, Edwin Sloper, 5, Boreham-terrace, Warminster
1890	Trans.		Beck, Charles Ridgeway, F.I.C., 33, Werter-road, Putney, S.W.
1874	Trans.		‖Beckett, George Henry, F.I.C., Glendye Cottage, Stevenston, Ayrshire
1901			Bedford, Frederick, B.Sc. (Lond.), 9, Market-place, Sleaford, Lincs.
1879	Trans.	C. 1895-9	Bedson, Peter Phillips, Prof., M.A., D.Sc. (Dun.), D.Sc. (Lond.), B.Sc. (Vict.), F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1901			Bedwell, John Cardew, B.Sc., 65, High-street, Colchester
1905			Bees, William James, B.Sc. (Lond.), 43, Ash-grove, Hyde-park, Leeds
1900			Beesley, Frederick Arnold, B.Sc. (Lond.), 11, Park-place, Greenwich, S.E.
1872	Trans.		‖Beilby, George Thomas, F.I.C., 11, University-gardens, Glasgow
1891			Belbin, Tom St. John, Capt., Nortonthorpe Hall, near Huddersfield
1883			Belcher, John Hope, B.A., B.Sc. (Lond.), Municipal Technical Institute, Coventry
1891			‖Bell, Albert Edward, F.I.C., Westminster College of Chemistry, Trinity-square, Borough, S.E.
1886	Trans.		Bell, Chichester Alexander, B.A., M.B. (Dublin), F.I.C., Brooklands, Dawlish, S. Devon
1889			Bell, Edward Wightman, High Bridge, Spalding
1899			Bell, Hugh Poynter, B.A. (Cantab.), 3, Mincing-lane, E.C.
1865	Trans.		‖Bell, J. Carter, A.R.S.M., F.I.C., The Cliff, Higher Broughton, Manchester
1889			‖Bell, Percy Carter, Milburn, New Jersey, U.S.A.
1904	Trans.		Bellars, Albert Ernest, B.A. (Cantab.), Magdalene College, Cambridge
1905			Belton, Francis George, 16, Clarkson-street, Sheffield
1879			Bemrose, Joseph, F.I.C., 56, St. Famille-street, Montreal, Canada
1874			‖Bendix, David, F.I.C., Sutherland Lodge, 371, Romford-road, Forest Gate, E.
1902			Benham, Keith Benham, A.I.C., Dean's Hill, Stafford
1881			‖Benjamin, Marcus, M.A., Ph.D., U.S. National Museum, Washington, D.C., U.S.A.
1904			Benn, R. H. Durward, West Mount, Montreal, Canada
1900			Bennett, Alexander Hutcheon, c/o Messrs. Ogston & Moore, Messina, Sicily

Date of Election.			
1904			Bennett, Charles Thomas, 57, Larkhall-rise, Clapham, S.W.
1903			Bennett, Colin Noël, 39, Elgin-mansions, Elgin-avenue, Maida Vale, W.
1900			Bennett, George Lowe, Rev., M.A. (Oxon.), 13, St. Domingo-vale, Everton, Liverpool
1905			Bennett, Joseph, Windsor Printing Co., North Adams, Mass., U.S.A.
1904			Benson, Alick Cole, 29, Caroline-street, Eaton-square, S.W.
1892	Trans.		Bensusan, Arthur John, 9, Carlton-mansions, Holland-park-gardens, W.
1904			Bentley, Walter Henry, B.A. (Oxon.), 18, Oaten-hill, Canterbury
1896	Trans.		Bentley, William Henry, B.Sc. (Vict.), 6, Woodbine-terrace, Irlam, near Manchester
1890			Bentz, Ernest, 107, Shaw-lane, Dinting, near Manchester
1902	Trans.		Bergtheil, Cyril, Mosheri Factory, Mozufferpore Post Office, Tirhoot, India
1900			Beringer, Heinrich Rowland, 11, Dolcoathe-road, Camborne, Cornwall
1882			‖Beringer, John Jacob, A.R.S.M., F.I.C., Basset-road, Camborne, Cornwall
1895			Berkeley, The Earl of, Foxcombe, Boar's Hill, Oxford
1890			‖Berncastle, Richard, 22, Aldridge-road-villas, Bayswater, W.
1893			Berridge, Douglas Jesse Penfold, M.A. (Oxon.), The Laboratory, Malvern College
1882			‖Berry, Edward Elhanan, F.I.C., 44, London Wall, E.C.
1899			Berry, Reginald Arthur, F.I.C., The West of Scotland Agricultural College, 6, Blythswood-square, Glasgow
1891			Berry, Thomas William, Education Office, Deansgate, Manchester
1888	Proc.		Berry, William, 7, Hampton-park, Redland, Bristol
1883	Trans.	{C. 1898-1900}	‖Bevan, Edward John, F.I.C., 4, New-court, Lincoln's Inn, W.C.
1886			Bevan, John William, F.I.C., Risedale, St. James-crescent, Swansea
1903			Beveridge, Wilfred William Ogilvy, Major, c/o Sir C. R. McGregor, Bart. and Co., 25, Charles-street, S.W.
1897			Bhaduri, Jyoti Bhushan, M.A., Krishnaghur, Dist. Nadia, Bengal, India
1903			Bhaduri, K., Prof., M.A. (Calcutta), Canning College, Lucknow, India
1903			Bibby, Charles Drake, 69, Queen's-road, Twickenham, Middlesex
1903			Bibby, Robert Gordon, New College, Oxford
1865			‖Bickerdike, William Edward, F.I.C., Bryers Croft, Wilpshire, near Blackburn
1902			‖Bickford, Harding, 46, Currie-street, Adelaide, South Australia

Date of Election.		
1875		Biggart, John William, F.I.C., Chemical Laboratory, 29, Cathcart-street, Greenock
1872		Biggs, C. H. W., 140, Salisbury-court, Fleet-street, E.C.
1881		Bingley, John, Northampton
1900		Binks, Frederick Nisbet, 42, Shortridge-terrace, Jesmond, Newcastle-on-Tyne
1894		Bird, William Rowland, Chem. Lab., G.W.R. Works, Swindon
1898		Birkett, Walter, 23, Carline-road, Lincoln
1879		‖Black, Andrew H., F.R.G.S., St. John's, Wakefield
1904		Black, John Wyclif, 20, Mardale-crescent, Edinburgh
1902		Black, Walter Geoffrey, A.I.C., The Limes, New-street, Braintree, Essex
1886		Blackburn, Thomas, Aruba Phosphaat Maatschappy, Curaçoa, West Indies
1899	Trans.	Blackman, Walter Lionel, Mostyn, Thornlaw-road, West Norwood, S.W.
1903		Blackshaw, George Neville, B.Sc. (Wales), Government School of Agriculture, Elsenburg, Mulder's Vlei, Cape Colony, S. Africa
1899		Blackshaw, John Frank, The Midland Dairy Institute, Kingston Fields, Derby
1903		Blair, Herbert, Harton Lodge, Harton, South Shields
1901		Blake, George Stanford, 8, The Vineyard, Richmond, Surrey
1890	Trans.	Blake, Robert Frederick, F.I.C., Chemical Department, Queen's College, Belfast
1890		Blake, William Henry, 12, Lombard-street, Newcastle-on-Tyne
1875		‖Blanshard, Charles Thomas, M.A. (Oxon.), 3, Seymour-villas Totnes
1892		Bleckly, Arthur Sanderson, Thelwall Lea, near Warrington
1902		Blenkinsop, Richard, Garden Wharf, Church-road, Battersea, S.W.
1890		Blenkinsop, W. E. B., c/o Messrs. May and Baker, Ltd., Garden Wharf, Church-road, Battersea, S.W.
1903		Bliss, Henry James Wheeler, M.A. (Oxon.) 10 Cornwall-gardens, S.W.
1899		Blofeld, Stuart, Rev., B.A., B.Sc. (Lond.), St. John's College Battersea, S.W.
1896		‖Blood, Maurice, M.A. (Oxon.), 16, Alexandra-road, Kingston-on-Thames
1891		Bloomer, Frederick John, F.I.C., Penpont, Clydach, R.S.O., Glamorgan
1890	Trans.	Blount, Bertram, F.I.C., 76 and 78, York-street, Westminster, S.W.
1888		Bloxam, Arthur George, F.I.C., 105, Birkbeck Bank Chambers, Southampton-buildings, W.C.

Date of Election.		
1883	Trans.	‖Bloxam, William Popplewell, Prof., B.Sc. (Lond.), F.I.C., The Clothworkers Research Laboratory, The University, Leeds
1903		Bluman, Nicholas John, 10, Amersham-road, New Cross, S.E.
1887		Blundstone, Edwin Richardson, B.A. (Cantab.), Heathfield, Hampton Hill, Middlesex
1865	Trans.	Blunt, Thomas Porter, M.A. (Oxon.), F.I.C., Tower-place, Shrewsbury
1896		Blyde, Joseph Edwin Alger, Merlin House, Broomgrove road, Sheffield
1875	Trans.	Blyth, Alexander Wynter, M.R.C.S. (Eng.), F.I.C., 29, Norfolk-road, N.W.
1892		Blyth, Meredith Wynter, B.A. (Cantab.), B.Sc. (Lond.), F.I.C., Chemical Laboratory, 36, Eastcheap, E.C.
1875		‖Boake, Arthur, Chemical Works, Stratford, E., and High-standing, Loughton, Essex
1902		Boardman, Ernest, B.Sc., 16, Hawthorne-road, Bolton
1899		Boardman, Thomas Henry, B.A. (Cantab.), Christ's Hospital, West Horsham, Sussex
1878		Bodmer, Richard, F.I.C., Analytical Laboratory, 16, Southwark-street, S.E.
1899		Bogert, Marston Taylor, Prof., B.A., Columbia University, New York City, U.S.A.
1899		Bolam, Robert Alfred, M.D. (Dun.), M.R.C.P., 3, Savile-place, Newcastle-on-Tyne
1869	Trans.	‖Bolas, Thomas, F.I.C., 60, Grove-park-terrace, Chiswick, W.
1901		Bolton, Edward Richards, 16, Flanchford-road, Ravenscourt Park, W.
1899		‖Bond, Alfred Ernest, Berkswell Lodge, near Coventry
1883		Bond, Henry C., M.A. (Oxon.), 11, Avenue-road, Grantham
1893	Trans.	‖Bone, William Arthur, D.Sc. (Vict.), Ph.D., F.R.S., The Victoria University, Manchester
1893		Boone, William Thomas, B.Sc. (Lond.), 6, Sydenham-villas, Cheltenham
1884		Borland, William Dalrymple, F.I.C., Beacon Lodge, Green Street Green, near Dartford, Kent
1881		‖Borns, Henry, Ph.D., 5, Sutton Court-road, Chiswick, W.
1895		‖Borradaile, Lancelot Alexander, M.A. (Cantab.), Selwyn College, Cambridge
1861		‖Bosanquet, Robert Holford Macdowall, M.A. (Oxon.), F.R.S., Castillo Zamora, Realijo Alto, Teneriffe, Canary Islands
1894	Proc.	Bose, Chuni Lal, Prof., 24, Mohendra Bose's-lane, Calcutta
1881		Bostock, George Henry, 86, Concord-avenue, Toronto, Canada

Date of Election.		
1881	Trans.	Bothamley, Charles Herbert, F.I.C., Tangle Wood, Southside, Weston-super-Mare
1887	Trans.	Bott, William Norman, Ph.D., The Vicarage, Sleaford, Lincs.
1873		Bottle, Alexander, 4, Godwyn-road, Dover
1869		‖Bottomley, James Thomson, M.A., D.Sc., F.R.S., F.R.S.E., 13, University Gardens, Glasgow
1886		Bottomley, William Beecroft, Prof., Ph.D., 35, Downside-crescent, Hampstead, N.W.
1894		Boul, William Good, M.A., LL.D., D.C.L. (Dub.), Tideswell Grammar School, near Buxton
1901		Bousfield, Edward George Paul, The Ozonised Oxygen Co., Ltd., 20, Mount-street, Manchester
1905	Trans.	Bousfield, William Robert, M.A. (Cantab.), K.C., M.P., St. Swithin's, Hendon
1891		Bovell, John Redman, Dodd's Botanical and Experimental Station, Barbados, West Indies
1865		‖Bowdler, Arthur Clegg, F.I.C., 20, Bank-terrace, Wellington-street, Blackburn
1903		Bowen, William, F.I.C., c/o T. Nock, Esq., Oleander, Fresno Co., California, U.S.A.
1888		Bower, Frank, c/o Messrs. Truman, Hanbury and Buxton, Spitalfields, E.
1894		Bowes, Harry, F.I.C., Messrs. Bowes and Sims, 40, Radford-street, Blackley, Manchester
1899		Bowles, Bertram H., Overdale, Eastwood-road, South Woodford, N.E.
1896		Bowley, Joseph John, 64, Redcliffe-gardens, South Kensington, S.W.
1893		Bowman, Frederic Edmund, Spinningfield, Deansgate, Manchester
1862		Bowman, Frederick Hungerford, F.I.C., F.R.A.S., F.L.S., F.G.S., Spinningfield, Deansgate, Manchester
1896		‖Bowman, Herbert Lister, M.A. (Oxon.), Greenham Common, Newbury, Berks
1894	Trans.	Boyd, David Runciman, Prof., D.Sc. (Glas.), Ph.D. (Heidelberg), F.I.C., The Hartley University College, Southampton
1901		Boyers, Henry, 20, Knox's-street, Sligo
1869		‖Braby, Frederic, Bushey Lodge, Teddington
1903		Bradbury, Samuel, Thornham New-road, Castleton, Lancs.
1895		Bradford, Henry, c/o W. H. Gorringe, Esq., Aberfeldy, Southwick, near Brighton
1876		‖Bradley, Nathaniel, Sunnyside, College-road, Whalley, Manchester
1888		Bradshaw, Charles, 169, Spring Vale-road, Sheffield

Date of Election.		
1894	Trans.	Brame, John Samuel Strafford, Royal Naval College, Greenwich, S.E.
1903		Branch, George Thomas, c/o Mr. Cleghorn, Chemist, Hout-street, Cape Town, South Africa
1904		Brand, Herbert Frank, M.A. (Lond.), 13, Clifton-road, Brockley, S.E.
1882		Branson, Frederic Woodward, F.I.C., 14, Commercial-street, and Wynneholme, Far Headingley, Leeds
1882	Trans.	Brauner, Bohuslav, Prof., Ph.D. (Prague), D.Sc. New Chemical Laboratory, Bohemian University, Prague, VI., Bohemia
1896		Bray, Daniel, Homeleigh Villa, Clydach-on-Tawe, Swansea Valley
1903		Brennand, Henry John Wolverton, B.A., M.B., Ch.M. (Sydney), 203, Macquarie-street, Sydney, N.S.W.
1905		‖Brettell-Vaughan, Edward Shipley Hewitt Edwards, c/o Messrs. R. W. Vicarey, Ltd., 91, Foregate-street, Stafford.
1883		Briant, Lawrence, 24, Holborn-viaduct, E.C.
1901		Bridges, Joseph Samuel, B.Sc. (Lond.), 45, Thistlethwaite-road, Clapton, N.E.
1904	Trans.	Bridgett, Robert Currie, M.A., B.Sc. (St. Andrews), 32, Queen Anne-street, Dunfermline, Fifeshire, N.B.
1897		Brierley, James, 18 and 19, French-street, Southampton
1890	Trans.	Brierley, John Thomas, Highfield, Golden Hill, Leyland, near Preston
1898		Brierley, Joseph, B.Sc. (Vict.), Ashton-road, Failsworth, Manchester
1893	Proc.	Briggs, John Frederick, 2, Frankfort-road, Herne Hill, S.E.
1905	Trans.	Briggs, Samuel Henry Clifford, B.Sc. (Vict.), Greenbank, Cleckheaton, Yorks
1883		‖Briggs, Thomas Lynton, F.I.C., 188, Central-avenue, Flushing, L.I., U.S.A.
1884		‖Briggs, William, M.A., LL.D., D.C.L. (Cantab.), "Owlbrigg," Chaucer-road, Cambridge
1902		Brincker, John Augustus Herman B.A. (Cantab.), M.B., B.S. (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), A.I.C., The Borough Hospital, Croydon
1898	Trans.	Brittain, Charles Edward, B.Sc. (Vict.), Grammar School, Normanton, Yorks
1900		Britten, Frank Curzon, B.A. (Oxon.), Odiham School, Odiham, Hants.
1889		Broadbent, Harry, F.I.C., 187, Hyde Park-road, Leeds
1879		‖Broadbent, John James, F.I.C., 14, Cross-street, Exchange, Manchester
1883		Brock, John, J.P., F.I.C., Gwern-Tyno, Colwyn Bay, N. Wales
1893		‖Brockbank, John Edwin, The Croft, Kirksanton, viâ Carnforth

Date of Election.			
1904			Broderick, George Edward Peach, B.Sc. (Lond.), Bryn Llewelyn, Lampeter, S. Wales
1884			Brodie, Sir Benjamin Vincent Sellon, Bart., M.A. (Oxon.), F.S.A., Brockham Warren, Betchworth, R.S.O., Surrey
1898			Brooke, Arthur, M.A., The Grammar School, Caistor, Lincs.
1900			Brooke, Charles Berjen, Colne House, Brantham, near Manningtree, Essex
1900			Brooke, John Richard, F.I.C., 20, Cullum-street, E.C.
1898			Brooks, Cecil Joslin, F.I.C., London-road, Thetford
1886	Trans.		‖Brothers, Horace Edward, B.Sc. (Lond.), F.I.C., Annsville, Glenburn Park, Belfast
1884		C. 1895-8	‖Brough, Bennett Hooper, A.R.S.M., F.I.C., F.G.S., 28, Victoria-street, S.W.
1876	Trans.		Brown, Adrian John, Prof., M.Sc. (Birm.), F.I.C., West Heath House, Northfield, Worcs.
1867	Trans.	C.1872-4 V.P.81-4 90-1 P. 91-3	Brown, Alexander Crum, Prof., M.A., M.D. (Edin.), D.Sc. (Lond.), LL.D. (Aberdeen), F.R.S., F.I.C., 8, Belgrave-crescent, Edinburgh
1870			Brown, David, F.I.C., 93, Abbey-hill, Edinburgh
1891			Brown, Edward Hilton, c/o Messrs. W. Ropes and Co., St. Petersburg, Russia
1873	Trans.	C. 1881-3	‖Brown, Frederic Douglas, Prof., B.Sc. (Lond.), University College, Auckland, New Zealand
1884			Brown, Frederic William, Ingleside, 39, Loveday-road, West Ealing, W.
1892			Brown, George Fitz-, A.R.S.M., F.I.C., The Broughton Copper Company, Ditton Copper Works, Widnes
1897			Brown, Gerald Noël, 20 Cullum-street, E.C.
1880			Brown, Henry, F.I.C., Benskin's Brewery, Watford, Herts.
1871	Trans.	C. 1883-7 V.P. 94-7 1904- T.1903-04	†Brown, Horace Tabberer, LL.D. (Edin.), F.R.S., F.I.C., 52, Nevern-square, Kensington, W.
1867	Trans.		‖Brown, James Campbell, Prof., D.Sc. (Lond.), F.I.C., 8, Abercromby-square, Liverpool
1882			Brown, Joseph, Ashleigh House, Savile Town, Dewsbury
1892			Brown, Reginald Busby, c/o The Badische Co., Ltd., 2, Samuel Ogden-street, Manchester
1884			Brown, William George, Prof., Ph.D., University of Missouri, Columbia, Missouri, U.S.A.
1896			Browne, Charles Edward, B.Sc. (Lond.), Christ's Hospital, West Horsham, Sussex
1893			Browne, Frank, Government Civil Hospital, Hong Kong, China

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† Longstaff Medallist, 1894.

Date of Election.		
1873		Brownen, George, Grove-road-east, Avon-park, Christchurch, Hants.
1899	Trans.	Browning, Kendall Colin, B.A. (Cantab.), 18, Cambridge Mansions, Cambridge-road, Battersea Park, S.W.
1890		Brownsword, Frank, M.Sc. (Vict.), F.I.C., Bryn Derwen, Old Colwyn, N. Wales
1902		Bruce, Alexander, B.Sc., The Laboratory, Hyde-park-corner, Colombo, Ceylon
1894	Trans.	Bruce, James, B.Sc. (Lond.), F.I.C., The Technical College, Huddersfield
1895		Bruckmann, Gustav Theodore, B.Sc., 192, Eighteenth-street, Brooklyn, N.Y., U.S.A.
1904		Brühl, Paul, Engineering College, Sibpur, near Calcutta, India
1899	Trans.	‖Brünnich, Johannes Christian, Dept. of Agriculture, Brisbane, Queensland
1893	Trans.	‖Brunton, John Dixon, c/o W. O. Richardson, Esq., Neviles-court, Cambridge
1903		Bryant, Vernon Seymour, B.A. (Cantab.), 80, Beeches-road, West Bromwich
1877	Trans.	‖Buch, Carl von, M.A. (Oxon.), F.I.C., 36, Great Marylebone-street, W.
1877	Trans.	Buchanan, John Young, M.A. (Cantab.), F.R.S., F.I.C., 26, Norfolk-street, Park-lane, W.
1876		‖Buckmaster, Charles Alexander, F.I.C., 16, Heathfield-road, Mill Hill Park, Acton, W.
1902		Bucknell, Edwin Thomas Holman, 19, Reservoir-road, Edgbaston, Birmingham
1904		Buggé, Erasmus Robert, 296, Burdett-road, Stepney, E.
1898	Trans.	Bull, Benjamin Samuel, M.A., B.Sc. (Ch. Ch. N.Z.), Ph.D. (Munich), F.I.C., Greylands, 104, Humber-road, Blackheath, S.E.
1901		Bult, Herbert John, 18, Billiter-street, E.C.
1890		Bunting, Henry Herbert, c/o Peruvian Corporation, Ltd., Lima, Peru
1896		Burbridge, James Kerry, F.I.C., The Orchard, Philip-lane, Tottenham, N.
1891		Burford, Samuel Francis, The Firs, Kirby Muxloe, near Leicester
1898		Burge, Charles Henry, F.I.C., Iddesleigh, Crescent-road, Kingston Hill, S.W.
1894	Trans.	Burgess, Herbert Edward, The London Essence Co., George-street, Camberwell Green, S.E.
1901		Burgess, Percival James, M.A. (Cantab.), Government Analyst, Singapore, Straits Settlements

Date of Election.		
1884		Burgess, William Thomas, F.I.C., 20, Priory-road, Bedford Park, W.
1903		Burghard, William Godsell, 180, High Holborn, W.C.
1884		‖Burland, Jeffrey Hale, 824, Sherbrooke-street, Montreal, Canada
1897		Burland, Richard Oxley, J.P., Poolstock House, Wigan
1849	Trans.	Burnard, Charles F., Plymouth Chemical Works, and Chatsworth Lodge, Compton Gifford, Plymouth
1885	Trans.	Burnett, Joseph Fearon, 8, River-view, Ashton, Preston
1901		‖Burnett, Theodore Ridley, B.Sc. (Vict.), Ph.D. (Basel), The Grammar School, Kirkby Lonsdale, Westmoreland.
1893		Burnham, John Charles, B.Sc. (Vict.), F.I.C., Cordite Factory, Wellington, Nilgiri Hills, India
1882	Trans.	Burrell, Benjamin Arthur, F.I.C., 8, Springfield Mount, Leeds
1902	Trans.	Burrows, Harry, Ph.D. (Heidelberg), A.R.C.S., F.I.C., The Green, Southgate, N.
1901	Trans.	Burrows, Merrick William, M.Sc. (Vict.), Dunkirk, Devizes
1891		Burton, William, Clifton Junction, near Manchester
1901		Burton, William, B.Sc. (Wales), 47, Humberstone-road, Cambridge
1903		Bury, Ernest, M.Sc., Brackley Coke Works, Little Hulton, near Bolton, Lancs.
1894		Bush, William, The Retreat, Clytha Park, Newport, Mon.
1904		Busher, Thomas Story, B.A. (Oxon.), Park Villa, Kendal, Westmorland
1890		Butcher, William J., Queen Elizabeth's Grammar School, Ashbourne, Derbyshire
1895		Butler, David Butler, 41, Old Queen-street, Westminster, S.W.
1890		Butler, William Waters, Southfield, Norfolk-road, Edgbaston, Birmingham
1894		Buttemer, Robert William, St. Mary's, Godalming
1875		Butterfield, John Cope, F.I.C., 79, Endlesham-road, Balham, S.W.
1892		Butterfield, William John Atkinson, M.A. (Oxon.), F.I.C., 66, Victoria-street, S.W.
1902		Buxy, Tarit Kanti, Prof., Government College, Jubbulpur, C.P., India
1888		Byrn, George Alexander, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1903		Bywaters, Hubert William, Ph.D. (Würzburg), A.R.C.S., A.I.C., 11, King-street, Regent-street, W.

Date of Election.		
1903		Cadman, William Henry, B.Sc. (Wales), Sandymount Castle, Dublin
1893		‖Cahill, Robert S., Sunnyside, Heckmondwike
1894	Trans.	‖Cain, John Cannell, D.Sc. (Vict. and Tübingen), 28, Pembury-road, Lower Clapton, N.E.
1905		Caldecott, Lawrence, 192, Upper Parliament-street, Liverpool
1898	Proc.	Caldecott, William Arthur, B.A., Box 67, Johannesburg, Transvaal, South Africa
1891		‖Calder, William A. S., Ormidale, Little Moor-hill, Smethwick, Birmingham
1905		Caldwell, Robert John, B.Sc. (Lond.), 40, Salehurst-road, Crofton Park, S.E.
1884		Caley, Edward J., Chapel Field Works, Norwich
1903	Trans.	Calvert, Harry Thornton, Ph.D. (Leipzig), B.Sc. (Vict.), F.I.C., West Riding of Yorkshire Rivers Board, Wakefield, Yorks.
1871		Calvert, Jonathan Hindle, Avenham Tower, Preston
1900		Calvert, Sidney, A.M. (Harvard), B.Sc. (McGill Univ.), State University, Columbia, Missouri, U.S.A.
1894		Cameron, Alexander, Whitcher-place, Rochester-road, Camden Town, N.W.
1893		Cameron, James, Ingleby, 70, Old Chester-road, Wood Hey, Rock Ferry, Birkenhead
1875		Cameron, John Macdonald, F.G.S., F.I.C., Castle Hill, Tain, N.B.
1892		Campbell, Andrew, The Palms, Dunneedaw, Rangoon, Burma
1905		Campbell, Eric William, 97, Eaton-square, S.W.
1905		Campbell, James H., 128, Wellington-street, Glasgow
1888	Trans.	Campbell, John Morrow, B.Sc., F.R.G.S., Blenheim-gardens, Wallington, Surrey
1903		Campbell, Thomas, 38, Eastbourne-street, Liverpool
1898		Campion, Alfred, F.I.C., 144, Wellington-street, Glasgow
1896		Candy, Hugh Charles Herbert, B.A., B.Sc. (Lond.), F.I.C., The College, London Hospital, E.
1884		Cannon, Matthew, 25, Stormont-road, Clapham Common, S.W.
1898		Cannon, Matthew J., 16 and 17, Devonshire-square, Bishopsgate-street, E.C.
1900		Cantin, Angélo, Prof., Royal College of Mauritius, Vacoas, Mauritius
1888		Carey, Alfred Edward, M.I.C.E., F.R.G.S., F.G.S., 3, Victoria-street, S.W.
1892	Trans.	Carey, Arthur, B.Sc., 1, Grassendale-road, Grassendale, near Liverpool
1902		Carmichael, Thomas Burnell, Parton, Whitehaven
1889		Carmody, Patrick, Prof., F.I.C., Government Laboratory, Port of Spain, Trinidad

Date of Election.			
1899	Trans.		‖Carpenter, Henry Cort Harold, M.A. (Oxon.), Ph.D. (Leipzig), National Physical Laboratory, Bushy House, Teddington, S.W.
1899			Carpmael, Wilfred, 24, Southampton-buildings, Chancery-lane, W.C.
1895	Trans.		Carr, Francis Howard, F.I.C., Kelvin, Church-avenue, Sidcup, Kent
1903			Carrier, Albert James, B.Sc. (Lond.), H.M. Patent Office, Chancery-lane, W.C.
1887			Carrington, George Carrington, Missenden Abbey, Great Missenden, Bucks.
1902			Carrodus, Fred., Glen Fern Tower, Lansdowne-road, Wimbledon, S.W.
1882			‖Carruthers, Robert, Kirkbank House, Dumfries
1893			Carswell, Thomas Retson, 50, Sandmere-road, Clapham, S.W.
1864		{C. 1878-82, 84-8}	‖Carteighe, Michael, F.I.C., 180, New Bond-street, W.
1901	Trans.		Carter, William, Sewage Works, Bury
1867			‖Carulla, Facundo J. R., Argyll-terrace, 84, Rose-hill-street, Derby
1895			Case, Thomas Bennett, B.A. (Oxon), 108, James's-street, Dublin
1879			‖Cassal, Charles Edward, Lieut.-Col., F.I.C., Town Hall, Kensington, W.
1903			Castell-Evans, John, F.I.C., 141, Ferme Park-road, Crouch End, N.
1902			Catchpole, Frederick Edward, 17, Sprules-road, Brockley, S.E.
1894			Catherall, Ezra, Heathmere, Albany-road, Harborne, Birmingham
1903			‖Caudwell, Ben, B.A. (Lond.), 28, Wigfull-road, Sheffield
1898	Trans.		Caven, Robert Martin, D.Sc. (Lond.), F.I.C., University College, Nottingham
1902			Challen, Matthew Bradbury, School of Mines, Daylesford, Victoria, Australia
1874			Chaloner, George, 30, Weston-park, Crouch End, N.
1880			Chamberlain, Arthur Garrett, 3, Market-place, Rugby
1883			Chambres, Gordon Crewe, Rev., Grammar School, Wigan
1883			‖Chance, Alexander M., c/o Messrs. Chance and Hunt, Ltd., Chemical and Cement Works, Oldbury
1902			‖Chance, Kenneth Macomb, B.A., The Bath Club, Dover-street, W.
1872			‖Chandler, Charles F., Prof., Ph.D., 51, East 54th-street, New York, U.S.A.
1872			Chandler, William H., Prof., Chem. Dept., Lehigh University, South Bethlehem, Pa., U.S.A.
1889			‖Chaplin, Edward Mitchell, Ph.D., Public Analyst's Office. Wakefield
1886	Trans.		Chapman, Alfred Chaston, F.I.C., 8, Duke-street, Aldgate, E.C.
1895			Chapman, Arthur Jenner, F.I.C., "Baronsmere," Stanhope Avenue, Church End, Finchley, N.

Date of Election.			
1899	Trans.		Chapman, David Leonard, B.A , 10, Parsonage-road, Withington, Manchester
1900	Trans.		Chapman, Edgar Marsh, F.I.C., Cairnsmore, Manor-road, Scarborough
1868			Chapman, Edward, Hill End, Mottram, Manchester
1891			Charles, Rhys Pendrill, F.I.C., Plâs Newydd, Neath
1900			Chater, Arthur Brand, 65, Queen-street, Brisbane, Queensland
1894	Trans.	C. 1900-03	Chattaway, Frederick Daniel, M.A. (Oxon.), D.Sc. (Lond.), Ph.D. (Munich), Hon. B.Sc. (Birm.), F.I.C., Longfield, Kenton-road, Harrow
1905			Chatterji, Hem Chandra, Prof., B.A. (Allahabad), Christ Church College, Cawnpore, India
1895			Cheadle, Walter William, M.A. (Oxon.), 36, London-road, Grays, Essex
1899			Cheater, Thomas John, B.Sc. (Lond.), 3, The Mansions, Star and Garter, Putney, S.W.
1909			Cheeseright, John Henry, B.Sc. (Lond.), 110, Balmoral-avenue, Gateshead-on-Tyne
1890			Cheetham, Thomas Arthur, 2, Doune-quadrant, Kelvinside North, Glasgow
1887			Chenhall, James Warne, M.I.C.E., Dart-villas, Totnes, Devon
1878			Cheshire, Horace Fabian, B.Sc. (Lond.), F.I.C., Woodside, Shornden, St. Leonards-on-Sea
1882			‖Chester, Edward D.
1897	Trans		Chikashigé, Masumi, B.Sc., Imperial University, Kyōtō, Japan
1871			Childs, Christopher, M.D. (Oxon.), Boscorne, Looe, Cornwall
1897			Cholerton, Alfred Foster, Beech Leigh, Harboro'-road, Leicester
1891	Trans.		‖Chorley, John Christmas, F.I.C., Bewsey, Oxford-road, Birkdale, Lancs.
1885			Christopher, Robert G., Walkden Works, Verney-road, Bermondsey, S.E.
1882			Chrystal, William James, F.I.C., 7, West George-street, Glasgow ; and Shawfield Works, Rutherglen, near Glasgow
1856	Trans.	{C. 1876-80, 87-90}	Church, Arthur Herbert, Prof., M.A., D.Sc. (Oxon.), F.R.S., F.I.C., Shelsley, Kew, Surrey
1903			Clacher, William, 50, Valentines-road, Ilford, E.
1888	Trans.		Claisen, Ludwig, Geh. Rath, Prof., Ph.D., Bleibtreustrasse, 38 and 39 II, Berlin, W., Germany
1901	Trans		Clark, Ernest, B.Sc. (Lond.), Royal Technical Institute, Salford, and 16, Havelock-street, Sheffield
1892			Clark, Ernest Victor, Woodlands, St. Anne's-crescent, Lewes
1905			Clark, Friend E., B.Sc. (Virg.), Ph.D. (Johns Hopkins Univ.), Pennsylvania State College, State College, Pa., U.S.A.
1876	Trans.		Clark, John, Ph.D. (Göttingen), F.I.C., 138, Bath-street, Glasgow

Date of Election.			
1905			Clark, Peter Skinner, M.B., C.M. (Glas.), Westpark, Cradock, Eastern Province, Cape Colony, South Africa
1905			Clark, Thomas Walter Firth, 42, Highbury Hill, N.
1905			Clarkson, George Douglas, Ash House, Mirfield, Yorks.
1902			Claudet, Arthur Crozier, A.R.S.M., F.I.C., 27, Daleham-gardens, Hampstead, N.W.
1852	Trans.		Claudet, Frederic, F.I.C., 6, Coleman-street, E.C.
1882	Proc.		Clayton, Edwy Godwin, F.I.C., 32, Holborn-viaduct, E.C.
1904			Clayton, Ellis, Municipal Technical Institute, Belfast
1893			Clayton, George, Northern College of Pharmacy, 100, Burlington-street, Manchester
1889			Clayton, John William, 3 and 5, Concert-street, Liverpool
1873	Trans.		Cleminshaw, Edward, M.A., F.I.C., Alkali Works, Oldbury, near Birmingham
1875			Clerk, Dugald, 18, Southampton-buildings, Chancery-lane, W.C.
1902			Clifford, William, Sewage Outfall Works, Wolverhampton
1878			Cloud, Thomas Charles, A.R.S.M., F.I.C., Coronation House, 4, Lloyds-avenue, Fenchurch-street, E.C.
1902			Clough, William Thomas, A.R.C.S., "Chelladene," St. Margaret's-road, Wanstead Park, Essex
1869	Trans.	C. 1885-90, 99-03	‖Clowes, Frank, Prof., D.Sc. (Lond.), F.I.C., 40, Craven-street, Charing Cross, W.C., and The Grange, College-road, Dulwich, S.E.
1902			Clowes, George Henry Alexander, Ph.D., Gratwick Research Laboratory, University of Buffalo, U.S.A.
1897			Clutterbuck, Medwin Caspar, B.Sc. (Lond.), Ph.D. (Strassburg), 61, Beaconsfield-villas, Brighton
1887			Coates, William Henry, M.A., M.B. (Dun.), M.R.C.S., L.R.C.P., L.S.A. (Lond.), 7, Albion-street, Hull
1896			Cobb, Walter William, M.A. (Oxon.), Hilton House, Atherstone
1890			Cobbold, Paul Alexander, M.A., Haileybury, Ontario, Canada
1895			Coblentz, Virgil, Prof., Ph.D., 115-119, W. 68th-street, New York, U.S.A.
1830			‖Cockburn, Arthur Cecil, The Grange, Otley, near Ipswich
1895	Trans.		Cockburn, George Bertram, B.A. (Oxon.), B.Sc., Lingdale Lodge, Birkenhead
1901			Cockburn, Thomas Kennedy, 148, Woodstock-avenue, Shawlands, Glasgow
1892			Cockerill, Thomas, Bolton, Colpetty-road, Colombo, Ceylon
1893			Cocking, Allan Thomas, Carhampton House, Four Oaks, Sutton Coldfield
1888			Cocking, Lewis Smith, Rashcliffe Dyewood Mills, Huddersfield
1903			Cockle, Charles, 44, Fairfield-road, Winchester

Date of Election.			
1901			Coddington, Eustace, M.A., 131, St. James's-road, Upper Tooting, S.W.
1903			Codling, Arthur John, 5, Tavistock-square, W.C.
1881			‖Coffin, Walter Harris, 26, Belgrave-road, Eccleston-square, S.W., and Kew Gardens, Surrey
1885	Trans.		Cohen, Julius Berend, Prof., Ph.D., The University, Leeds
1901			‖Cohen, Robert Waley, B.A., 15, Hyde-park-square, W.
1900			Cole, Oscar Joseph, B.A. (Lond.), Park-road, Wivenhoe, Essex
1891	Trans.		Colefax, Arthur, M.A., Ph.D., 4, Brick-court, Temple, E.C.
1883			Coleman, Joseph Bernard, F.I.C., S.W. Polytechnic Institute, Manresa-road, Chelsea, S.W.
1883			Collenette, Adolphus, Brooklyn, Fort-road, Guernsey
1873			‖Collens, Edward, Stourbank House, Stourport, Worcs.
1905			Colles, William Morris, jun., B.Sc. (Lond.), 16, Birchington-road, West Hampstead, N.W.
1881			Collett, John Marton, Hillfield, Gloucester
1885	Trans.	C. 1889-94, 1900-1	‖Collie, John Norman, Prof., Ph.D. (Würzburg), F.R.S., F.I.C., 16, Campden-grove, Kensington, W.
1897			Collingridge, Frank, B.Sc. (Lond.), F.I.C., 45, Beaufort-road, Edgbaston, Birmingham
1892			‖Collins, Hugh Brown, B.Sc., 42, Crossloan-road, Glasgow, N.B.
1890			‖Collins, Sydney Hoare, F.I.C., Armstrong College of Science, Newcastle-on-Tyne
1888			Collins, Walter Hepworth, c/o Messrs. Edward Wihl & Co., 17, Nicholas-street, Manchester
1905			Collitt, Bernard, 79, Eastbourne-terrace, Gainsborough
1887	Trans.		‖Colman, Harold Govett, Ph.D. (Würzburg), M.Sc. (Vict.), F.I.C., Elmside, Worcester Park, Surrey
1890			Colwell, James Kear, F.I.C., Clerkenwell Town Hall, Rosebery-avenue, E.C.
1900			Comber, Albert Walter, F.I.C., Suramangalam, Salem District, S. India
1892			‖Comyns, Frank, M.A., The Lindens, Newbury, Berks.
1891			Congdon, Ernest A., Prof., The Drexel Institute of Art, Science, and Industry, Chestnut-street, Philadelphia, Penn., U.S.A.
1899			Connah, James, B.Sc. (Lond.), F.I.C., The Laboratory, Custom House, E.C.
1875			Connor, Charles C., B.A., 4, Queen's Elms, Belfast
1883			‖Conrad, Edwin Charles, Manor House, Chalk, Gravesend
1902			Cook, Arthur James, 167, Richmond-road, Hackney, N.E.
1875	Trans.		‖Cook, Ernest Henry, D.Sc. (Lond.), F.I.C., The Clifton Laboratory, 27, Berkeley-square, Clifton, Bristol
1895			Cook, Herbert William, B.Sc. (Lond.), The Technical Institute, Tunbridge Wells, Kent

Date of Election.		
1890		Cooke, Arthur William, c/o Messrs. Brotherton and Co., Holmes-street, Dewsbury-road, Leeds
1888		Cooley, Walter Bromley, 5, Dudley-street, Wolverhampton
1889		Cooper, Albert, Grimston Lawn, Haven Green, Ealing, W.
1898		‖Cooper, Albert John Bullen, Grimston Lawn, Haven Green, Ealing, W.
1892		Cooper, Arthur James, B.A. (Dub.), B.Sc. (Lond.), F.I.C., Brewood School, Staffs.
1888		Cooper, Astley, Clifford, near Boston Spa, R.S.O., Yorks.
1905		Cooper, Jabez Horace, B.A. (Oxon.), M.B., B.S., B.Sc. (Dun.), 13, Victoria-terrace, Exeter
1898		Cooper, John Burdon-, Glenartney, Poole-road, Bournemouth
1900		Cooper, William Francis, B.A. (Cantab.), 7, Grosvenor-road, Watford
1891		Cooper, Walter Johnson, South Wales Cement Works, Penarth, near Cardiff
1897		Cooper, William Ransom, M.A., B.Sc. (R.U.I.), A.C.G.I., A.I.C., 113, Tulse Hill, S.W.
1894	Proc.	Coote, Arthur Herbert, Garwood, 36, Humber-road, Blackheath, S.E.
1899	Trans.	Cope, Frank, 92, Bradford-road, Dewsbury
1890		‖Coppock, John Bridgeford, B.Sc. (Lond.), F.I.C., The Technical School, Kendal
1891	Trans.	Corbett, Charles Henry, The Avenue, Trowbridge, Wilts.
1901	Trans.	Cormack, William, c/o Messrs. G. Nelson Dale & Co., Emscote Mills, Warwick
1888		‖Cornish, Vaughan, D.Sc. (Vict.), 31, Kensington-gardens-square, Bayswater, W.
1890		Corrie, David, Nobel's Explosives Company, West Quarter Factory, Polmont Station, N.B.
1893	Trans.	Coste, John Henry, F.I.C., 54, Alconbury-road, Upper Clapton, N.E.
1892		‖Couldrey, Henry, H.M.'s Mint, Bombay, India
1905		Coupe, Miles, 46, Millarbarn-lane, Waterfoot, near Manchester
1900		Courtman, Ernest Owen, Denford House, Atkins-road, Clapham Park, S.W.
1903		‖Cousins, Francis George, 16, Old Elvet, Durham
1901	Trans.	Cousins, Herbert Henry, M.A. (Oxon.), Government Laboratory, Kingston, Jamaica
1885		Cousins, William James, F.I.C., 17, Temple-chambers, Temple-avenue, E.C.
1886	Trans.	‖Coutts, Francis James Henderson, M.D., D.P.H. (Vict.), 264, Hornby-road, Blackpool
1898		Cowburn, Arthur William, 29, Princess-street, Manchester

Date of Election.			
1882			‖Cowie, Thomas R., Garnkirk House, Garnkirk, N.B.
1905			Cowie, William Beaverly, 26, East Claremont-street, Edinburgh
1898			Cowling, Frederick, Technical Schools, Clay Cross, near Chesterfield
1873			Cownley, Alfred John, F.I.C., 225, Barry-road, Dulwich, S.E.
1904			Cowper, Alfred Denys, 121, Castellain-mansions, Maida Vale, W.
1888			Cowper, Joseph, 50, King-street, Penrith
1886			Cox, Ebenezer John, 114, Greenfield-road, Harborne, Birmingham
1898			Cox, Frederick Hudson-, F.I.C., 46, St. James'-road, Brixton, S.W.
1873			Cox, Samuel Herbert, 13, St. Helen's-place, London, E.C.
1903			Coyle, Benjamin Claxton, City Laboratory, 17, Castle-street, Dublin
1904			Crabb, William, B.Sc. (Lond.), The Grammar School, Penistone, Yorks.
1901			Crabtree, Arthur, 148, Westgate-road, Newcastle-on-Tyne
1870	Trans.		Crafts, James Mason, Prof., 59, Marlborough-street, Boston, Mass., U.S.A.
1892	Trans		Craig, Andrew William, College of Pharmacy, 360, Swanston-street, Melbourne, Victoria
1875			‖Crampton, George.
1897			Cranfield, William, The Higher Grade Board School, Halifax
1897			Creasey, Clarence Hamilton, Beechwood, Thorn-park-road, Plymouth
1875			Cresswell, Charles Gerard, F.I.C., Ermyngarth, Ashtead, Epsom
1887			‖Cribb, Cecil Howard, B.Sc. (Lond.), F.I.C., 136, Shaftesbury-avenue, W.
1878			‖Criper, William Risdon, A.R.S.M., F.I.C., Chemical Works, Konnagar, Calcutta
1895			Crocker, Charles, Norman House, St. Peter's-road, Cockett, Swansea
1902	Trans.		Crocker, James Codrington, B.A., South Western Polytechnic, Manresa-road, Chelsea, S.W.
1901			Crocker, Walter Stevens, 39, Arnold-street, Princes Park, Liverpool
1897	Trans.		Crofts, James Murray, M.A. (Cantab.), B.Sc. (Lond.), The College, Barnato Park, Johannesburg, South Africa
1886	Trans.		‖Crompton, Holland, Binfield, Chester-road, Northwood, Middlesex
1902			Crookes, Henry, 109, Ladbroke-grove, Notting Hill, W.
1901			Crookes, Samuel Irwin, Richmond, 113, Heythorp-street, Southfields, S.W.
1857	Trans.	C. 1866-70 V.P. 76-9, 85-7 P. 87-9	‖Crookes, Sir William, D.Sc. (Oxon.), F.R.S., F.I.C., 7, Kensington Park-gardens, W., and Athenæum Club, Pall Mall, S.W.

Date of Election.			
1879	Trans.	C. 1890-1 93-5	‖Cross, Charles Frederick, F.I.C., 4, New-court, Lincoln's Inn, W.C.
1890	Trans.	C. 1901-2 S. 1905-	‖Crossley, Arthur William, Prof., D.Sc. (Vict.), Ph.D. (Würzburg), F.I.C., Pharmaceutical Society, 17, Bloomsbury-square, W.C., and 10, Crediton-road, West Hampstead, N.W.
1901			Crossley, Frank, Duchy Bank, Seedley-road, Pendleton, Manchester
1896			Crossman, Charles Matthew, B.Sc. (Lond.), 10, Oseney-crescent, Camden-road, N.W.
1895			Crossman, Tom, 40, Coldhurst-street, Oldham
1899			Crouch, William Samuel, 265, Glossop-road, Sheffield
1880	Trans.		Crow, John Kent, D.Sc. (Lond), F.I.C., Tressillian, Ulundi-road, Blackheath, S.E.
1887			‖Crowther, Horace Woodward, F.I.C., The Beeches, West Bromwich
1895			Croysdale, John, Whitley Bridge, R.S.O., Yorks.
1884			Crumbie, William D., 146, Washington-street, East Orange, New Jersey, U.S.A.
1887	Trans.		Cundall, James Tudor, B.Sc. (Lond.), F.I.C., Edinburgh Academy, Henderson-row, and 1, Dean-park-crescent, Edinburgh
1905			Cunningham, James Edward, 21, Blenheim-gardens, Willesden Green, N.W.
1899	Trans.		Cunnington, Alfred Valentine, B.A. (Cantab.), c/o Messrs. Brunner, Mond & Co., Northwich
1875			Curphey, William Salvador, F.I.C., Borva, Lenzie, N.B.
1900			Cussons, John, B.Sc. (Vict.), Hamburg, Peddie, Cape Colony, South Africa
1881			‖Custance, John D., Prof., Park-road, Cowes, Isle of Wight
1895			Cuthbertson, L. M. G., 89, Lordship Park, N.
1894			Dains, Herbert Henry, F.I.C., 27, Inderwick-road, Stroud Green, N.
1901	Trans.		Dakin, Henry Drysdale, D.Sc. (Vict.), F.I.C., 819, Madison-avenue, New York, U.S.A.
1905			Dalton, William Herbert, F.G.S., 85, Hayter-road, Brixton Hill, S.W.
1901			Daniel, Gilbert Howard, B.Sc. (Lond.), 25, Church-walk, Ulverston
1897			Daniell, John, c/o Rose Deep, Ltd., Box 6, Germiston, Transvaal
1887			Daniell, L. C., Royal Standard Brewery, Tamworth, N.S.W.
1902			Daniels, James Ward, Westwood, Medomsley, R.S.O., Durham

Date of Election.		
1850		‖Danson, Joseph.
1892		Darbishire, Francis V., B.A. (Oxon.), Ph.D., South Eastern Agricultural College, Wye, Kent
1852		Darby, Stephen, F.I.C., Cookham Dean, Berks.
1899		Darling, Charles Robert, A.R.C.S.I., A.I.C., Bryniach, Brent-road, Plumstead, Kent
1891		Darling, Thomas, Adderstone House, Berwick-on-Tweed
1871	Trans.	‖Darling, William Howarth, F.I.C., 26, Dover-street, Manchester
1893		Davey, George, 34, Carlton-vale, Maida-vale, W.
1875		‖Davey, G. W., 23, Melbourne-road, East Ham, E.
1897		Davidge, Henry Norris, 1, Rydal-gardens, Rydal-road, Streatham, S.W.
1900		Davidson, Alexander, F.I.C., 2, Hamilton-park-terrace, Hillhead, Glasgow
1901		Davidson, John Howard, B.Sc. (Vict.), Goldenhill, Stoke-on-Trent
1876		‖Davidson, Joseph, Green Bank, Holywell Green, Halifax
1899	Trans.	Davidson, William Brown, M.A., D.Sc. (Aberdeen), Ph.D. (Würzburg), F.I.C., Saltley Gas Works, Birmingham
1866	Trans.	‖Davies, Arthur Ellson, Ph.D., Tweedbank, West Savile-road, Edinburgh
1858	Trans.	Davies, Edward, F.I.C., The Laboratory, 28, Chapel-street, Liverpool
1896		Davies, Llewellyn John, Bute-chambers, Bute-road, Cardiff
1894		Davies, Samuel Henry, B.Sc. (Vict.), Rowntree's Cocoa Works, York
1900		Davis, Arthur Charles, 2, Downing-grove, Cambridge
1902		Davis, Charles Benson, c/o Dr. Francis Wyatt, S.W.-corner, 23rd-street, and 9th-avenue, New York, U.S.A.
1901		Davis, Francis, Forest Villa, Ovendon, Halifax, Yorks.
1902		Davis, Frederick, B.Sc. (Vict.), Hazel House, Hayfield, near Stockport
1902		Davis, Henry Wilson, F.I.C., Farleigh, Crescent-road, Kingston Hill, S.W.
1857		‖Davis, J. Frederick, F.G.S., c/o J. Lewis, Esq., Government Laboratory, Parliament-street, Cape Town, South Africa
1872	Trans.	‖Davis, Richard Hayton, 23, Regent-parade, Harrogate
1876		Davis, Thomas Sebastian, 199, South Lambeth-road, S.W.
1897	Trans.	Davis, William Alfred, B.Sc. (Lond.), Central Technical College, South Kensington, S.W.
1876		‖Davis, Walter Charles, The Chestnuts, Durdham Down, Bristol
1900		Davison, Thomas C., 48, Victoria-road, New Swindon, Wilts.

Date of Election.			
1895			Daw, Frederic Weldon, A.R.C.S., F.I.C., Eureka-place, Ebbw Vale, Mon.
1900	Trans.		Dawson, Harry Medforth, B.Sc. (Lond.), Ph.D., The University, Leeds, and North-terrace, Bramley, Leeds
1899			Dawson, Henry Royal, c/o Messrs. Peyton and Son, Lister-street, Birmingham, and 6, Wimbourne-road, Ebgbaston, Birmingham
1890			Day, Charles Edwin, B.Sc., The Mines, Coniston, Lancs.
1881	Trans.		‖Day, Thomas Cuthbert, 36, Hillside-crescent, Edinburgh
1905			Day, William Walpole, B.Sc. (Wales), Llandilo, Attleborough-road, Nuneaton
1901	Trans.		Dean, George, M.A. (Cantab.), 4, Empress-avenue, Ilford, E.
1905			Deane, Harold, B.Sc. (Lond.), A.I.C., 34, Drakefield-road, Upper Tooting, S.W.
1886			Deane, Leopold Mandeville, Davington House, and The Cotton Powder Co., Ltd., Faversham
1859	Trans.	V.P. 1871-4	Debus, Heinrich, Prof., Ph.D., F.R.S., Schlangenweg 4, Cassel, Provinz Hessen, Germany
1899			‖De Castro, John Paul, M.A. (Cantab.), F.I.C., Laboratory and Assay Office, Effingham House, Arundel-street, Strand, W.C.
1885	Trans.		Dechan, Martin, F.I.C., Laboratory of Public Analyst, Hawick
1874			Deck, Arthur, Hollydene, Tenison-avenue, Cambridge
1904			Deeks, William Thomas, High-street, Shanklin, Isle of Wight
1869	Trans.		‖Deering, William Henry, F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1900	Proc.		Deerr, Noël Fielding, Blairmont, Berbice, British Guiana
1902			De la Rue, Evelyn Andros, B.A. (Oxon.), 81, Westbourne-terrace, W.
1905			De Lury, Ralph Emerson, M.A. (Toronto), 110, Bedford-road, Toronto, Canada
1892			Denison, Joseph R., Lingholme, Heaton, Bradford
1902			Dennis, William, c/o Messrs. G. Coverdale, Ltd., Regent Chemical Works, Anlaby-road, Hull
1904			Derwent, Ernest, 915, Offuere-street, Portsmouth, Ohio, U.S.A.
1903	Trans.		Desch, Cecil Henry, D.Sc. (Lond.), Ph.D. (Würzburg), F.I.C., Instow, Mount Pleasant-road, South Tottenham, N.
1897			Deverell, Louis Charles, Straits Trading Co., Singapore, Straits Settlements
1870	Trans.	C. 1874-7 V.P. 80-3 86-8, 96-7 P. 97-9	‖Dewar, Sir James, M.A. (Cantab.), Hon. LL.D. (St. Andrews, Aberd., Edin., Glas.), Hon. D.Sc. (Oxon., Dub., Vict., Ireland), F.R.S., F.I.C., Royal Institution, Albemarle-street, W.
1900			Dewhirst, John Arthur, F.I.C., 13, Highfield-terrace, Nab Wood, Saltaire, Bradford
1880			Dibdin, William Joseph, F.I.C., Mayfield, Grange-road, Sutton, Surrey

Date of Election.			
1872			‖Dickinson, Arthur John, F.I.C., Truro Villa, 57, Lewisham-high-road, S.E.
1904			Dickinson, Francis, 26, O'Connell-avenue, Dublin
1898			Dickson, Samuel, Chemical Laboratory, 2, Broadway, Westminster, S.W.
1860	Trans.	C. 1873-4 V P. 1900-03	‖Divers, Edward, Prof., M.D., D.Sc. (R.U.I.), F.R.S., F.I.C., 3, Canning-place, Palace Gate, W.
1903			Divine, Thomas, M.B., C.M. (Glas.), D.P.H. (Lond. and Cantab.), Public Health Department, Huddersfield
1897			Dixon, Andrew James, F.I.C., Girton, McLaren-street, North Sydney, N.S.W.
1885	Trans.	C. 1900-	Dixon, Augustus Edward, Prof., M.D. (Dub.), Queen's College, and Fernhurst-avenue, Western-road, Cork
1896	Trans.		Dixon, Frank, B.Sc., The Institute, Lydney, Gloucester
1894	Proc.		‖Dixon, George, M.A. (Cantab.), Trinity College, Cambridge, and St. Bees, R.S.O., Cumberland
1876	Trans.	C. 1892-6 V.P. 1904-	‖Dixon, Harold Baily, Prof., M.A. (Oxon.), F.R.S., The University, Manchester
1893			Dixon, Harry William, Clarence Iron and Steel Works, Leeds
1902			Dixon, John Kemp Smith, c/o Messrs. H. Richardson & Co., Chemical Manure Manufacturers, York
1890			Dixon, William, 4, Park-place-east, Sunderland
1895			Dixon, William, 102, Spring-street, Bury
1862			Dixon, William Adam, F.I.C., 97, Pitt-street, Sydney, N.S.W.
1882	Trans.	C. 1901-	Dobbie, James Johnston, Prof., M.A. (Glas.), D.Sc. (Edin.), F.R.S., F.I.C., Museum of Science and Art, Edinburgh
1887	Trans.		Dobbin, Leonard, Ph.D. (Würzburg), F.I.C., Chemical Laboratory, New University-buildings, Edinburgh
1898			Dodd, Frederick Robertson, F.I.C., Victoria-villas, 139, Burscough-street, Ormskirk
1901			Dodd, Robert, 28, Sibella-road, Clapham, S.W.
1886			Dodd, W. Ralph, "Frederwen," Village-road, Enfield, N.
1892			Dodds, George Price, 14, St. Luke's-terrace, Darlington
1905			Dodds, Roger, Kingswood School, Bath
1897	Proc.		Dodgson, John Wallis, B.Sc. (Lond.), University College, Reading
1894	Proc.		Doherty, William Michael, F.I.C., Government Laboratory, Sydney, N.S.W.
1900			Donald, William, Saltcoats, Ayrshire
1892			Donaldson, Hudson, The Laurels, St. Catharine's-road, Grantham
1901	Trans.		*Donnan, Frederick George, Prof., M.A., Ph.D., University Chemical Laboratory, Brownlow-street, Liverpool
1897	Trans.		Dootson, Frederick William, M.A. (Cantab.), D.Sc. (Dublin), F.I.C., University Chemical Laboratory, Cambridge

Date of Election.		
1902		Dorée, Charles, M.A. (Oxon.), B.Sc., Seafield Park College, Fareham, Hants.
1900		Dougall, James Dick, Senhouse-street, Maryport, Cumberland
1888		‖Douglas, William, F.I.C., Diamond, Demerara, British Guiana
1884		Down, Frederick Johnathan, Glengariff, Milton-road, Harpenden, Herts.
1899		Doyle, Frederick, Oakdene, Scotland-road, Slanwix, Carlisle
1899		Drake, Francis Alfred, B.Sc. (Lond.), 24, Cavendish-square, Hull
1884		Draper, Henry Carter, 68, Wodehouse-terrace, North Circular-road, Dublin
1891		Dreaper, William Porter, F.I.C., Woodcroft, Felixstowe, S.O., Suffolk
1893		Dreyfus, Charles, Ph.D., The Clayton Aniline Co., Clayton, Manchester
1903		Drought, James Justinian, Molo, *viâ* Mombasa, British East Africa, and The New Club, Johannesburg
1895		Druce, Edric, County Agricultural Institute, Ridgmont, Aspley Guise, R.S.O.
1904	Trans.	Drugman, Julien, Ph.D. (Bonn), The University, Manchester
1901		Dubois, Raymond, B.Sc. (Paris), Viticultural College, Rutherglen, Victoria, Australia
1897		Duckham, Alexander, Phœnix Wharf, West Ferry-road, Millwall, E.
1901		Duckworth, William Henry, Blackburn Corporation Sewage Works, Samlesbury, near Preston
1900		Dudderidge, Frank Rawlinson, 45, Sidney-grove, Newcastle-on-Tyne
1898		Dudley, Charles Benjamin, Ph.D., Drawer 334, Altoona, Penn., U.S.A.
1890		‖Dudley, William L., Prof., Vanderbilt University, Nashville, Tennessee, U.S.A.
1892		Duffield, Walter William, 4, Cortayne-road, Hurlingham, S.W.
1893	Trans.	‖Dufton, Samuel Felix, M.A., D.Sc. (Cantab.), Laurel Bank, Claremont-road, Headingley, Leeds.
1897		Dufty, Lawrence, 8, Clarke-street, Sheffield
1884		Duggan, Thomas Richard, F.I.C., 60, Foyle-road, Blackheath, S.E.
1889		Duisberg, Carl, Ph.D., Elberfeld, Germany
1889		‖Dukes, Thomas William, P.O. Box 10, Vryheid, South Africa
1881		Duncan, Arthur William, 1, Trafalgar-road, Higher Bentcliffe, Pendleton, Manchester
1894	Proc.	‖Duncan, Cecil Cooke, F.I.C., The Shire Hall, Worcester
1891		Duncan, William, F.I.C., The Laboratory, 65, Bath-row, Edgbaston, Birmingham

Date of Election.			
1896			Duncan, William, Royal Dispensary, 21, West Richmond-street, Edinburgh
1894	Proc.		||Dunn, Frederic, 193, Collins-street, Melbourne, Australia
1882			Dunn, John Thomas, D.Sc. (Dun.), F.I.C., 10, Dean-street, Newcastle-on-Tyne
1893			Dunnington, Francis P., University of Virginia, Charlottesville, U.S.A.
1899			Dunscombe, Frederick Charles, c/o Electric Reduction Co., Buckingham, Quebec, Canada
1901	Trans.		Dunstan, Albert Ernest, B.Sc. (Lond.), 18, Wiesbaden-road, Stoke Newington, N.
1885			Dunstan, Malcolm James Rowley, M.A. (Oxon.), F.I.C., The College, Wye, Kent
1905			Dunstan, Sydney, The Royal Infirmary, Newcastle-on-Tyne
1879	Trans.	C. 1888-91 S. 93-1903 V.P. 1903-	||Dunstan, Wyndham Rowland, Prof., Hon. M.A. (Oxon.), LL.D. (Aberdeen), F.R.S., F.I.C., Imperial Institute, S.W.
1860	Trans.	C. 1871-5	Dupré, August, M.A., Ph.D. (Heidelberg), F.R.S., F.I.C., 2, Edinburgh Mansions, Howick-place, S.W.
1896			Durant, Henry Thomas, The Rhodesia Gold Fields, Ltd., Bulawayo, Matabeleland, South Africa
1871			||Durham, Henry, 13, Coleherne-road, South Kensington, S.W.
1883	Proc.		Durrant, Reginald Graham, M.A. (Oxon.), The College, Marlborough, Wilts.
1892			Duxbury, Thomas, 17, Grosvenor-chambers, Deansgate, Manchester
1875	Trans.	C. 1893-7 1904-	||Dyer, Bernard, D.Sc. (Lond.), F.I.C., 17, Great Tower-street, E.C.
1890	Trans.		Dymond, Thomas Southall, F.I.C., Board of Education, South Kensington, S.W.
1885	Trans.		Dyson, Gibson, Ph.D., Venn Farm, Marden, Hereford
1883	Trans.		||Dyson, Septimus, 8, Belmont-avenue, Harrogate
1905			Eade, Samuel George, 10, Eagle-street, Port Talbot, South Wales
1876			||Earp, Francis Salsbury, Ph.D. (Giessen), F.I.C., 72, Addis-street, Kalgoorlie, West Australia
1889	Trans.		||Easterfield, Thomas Hill, Prof., M.A. (Cantab.), Ph.D. (Würzburg), F.I.C., The Victoria College, Wellington, New Zealand
1891			Eastick, Charles E., Martineau's Refinery, King Edward-street, Whitechapel, E.

Date of Election.		
1881		Eastick, John Joseph, F.I.C., Millaquin Refinery, Bundaberg, Queensland
1901		Eastick, Samuel Philip, Kongsberg, Norway
1903		Eastwood, Arthur William, B.A. (Cantab.), Newton College, Newton Abbot, South Devon
1878	Trans.	‖Eccles, Herbert, Briton Ferry Steel Works, Briton Ferry, Glamorganshire
1881		Edgell, Richard Arnold, Rev., M.A. (Oxon.), Sywell House, Llandudno, Wales
1903		Edgerton, John Percy, The Laboratory, 61, Cornhill, E.C.
1903		Edlin, Edgar Leeder, B.A. (Oxon.), 31, All Saints-road, Leicester
1903		Edminson, Sidney Robert, Maritzburg College, Natal, South Africa
1893		Edwards, Thomas, Brewery House, Rhymney, viâ Cardiff
1884		Edwards, Vincent, F.I.C., Lawes' Chemical Manure Co., Barking Creek, Essex
1902		Edwards, Walter Henry, Adswood, Church End, Finchley, N.
1892		Edwards, Walter N., 6, Shardcroft-avenue, Herne-hill, S.E.
1898		‖Edwards, Wilbraham Tollemache Arthur, F.I.C., Experiment Station, Réduit, Mauritius
1887		‖Ehrhardt, Ernest Francis, D.Sc., Ph.D., Badische Anilin und Soda Fabrik, Ludwigshafen-am-Rhein, Germany
1899		Eichenauer, William Frederick, 18, Maryon-road, Old Charlton, Kent
1864	Trans.	Ekin, Charles, F.I.C., 143, New Bond-street, W.
1883		‖Ekins, Arthur Edward, F.I.C., Rushden, Lattimore-road, St. Albans
1887		Elborne, William, M.A. (Cantab.), Chemical Laboratory, Minster Precincts, Peterborough
1903		Elford, Archibald Sefton, B.A. (Oxon.), Oak Cottage, Park-road, Chelmsford
1891		Elford, Percy, M.A. (Oxon.), St. John's College, Oxford
1901		Eling, Thomas Henry James, B.A. (Cantab.), Nelson Endowed School, Wigton, Cumberland
1878		‖Elliott, Arthur H., Ph.D., c/o Consolidated Gas Co., 4, Irving-place, New York City, U.S.A.
1896	Trans.	Elliott, Walter John, M.A. (Cantab.), Woodcroft, Lichfield-road, Stafford
1893		Ellis, Charles Sordes, F.I.C., Meadowlead, Station-road, Harrow
1900		Ellis, Frederic Richard, 15, Shadwell-road, Bishopston, Bristol
1904		Ellis, Henry Russel, 177, Warwick-road, Kensington, W.
1901		Ellis, Hugh Edward, Preswylfa, Llanfair, near Welshpool
1878		Ellis, William Hodgson, M.A., M.B. (Toronto), F.I.C., School of Practical Science, Toronto, Ontario, Canada
1892		Ellison, Henry, jun., Whitechapel-road, Cleckheaton

Date of Election.		
1893		Elmore, Alexander Stanley, 4, Broad-street-place, E.C.
1902		Elsden, Alfred Vincent, B.Sc. (Lond.), A.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E.
1886	Trans.	Elworthy, Herbert Samuel, Hamara Ghar, Battlefield-road, St. Albans, Herts.
1885		Embrey, George, F.I.C., County Laboratory, Brunswick-road, Gloucester
1887		‖Emmons, Hamilton.
1901		English, Robert, Engineer and Manager, Christchurch Gas Co., Christchurch, New Zealand
1892		Entwistle, Herbert, 13, Curzon-avenue, Victoria-park, Manchester
1899		Epps, James Washington, 95, Upper Tulse Hill, S.W.
1889		Erskine, James Kerr, New Kleinfontein Co., Ltd., Post Office, Benoni, Transvaal, South Africa
1883	Trans.	Esilman, Alexander, Fleetwood Lodge, 25, Roe-lane, Southport
1862		‖Esson, William, Prof., F.R.S., Merton College, Oxford
1865		‖Estcourt, Charles, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1899		Estcourt, Harry Estcourt, 467, West-street, Durban, Natal, South Africa
1888		‖Estcourt, Philip Anderson, F.I.C., Seymour House, Seymour-grove, Old Trafford, Manchester
1894		Eumorfopoulos, Nicholas, B.Sc., 33, Gloucester-square, Hyde Park, W.
1895		Eutroppe, Arthur T., c/o Chief Surgeon, Division of the Philippines, Manila, Philippine Islands
1905		Evans, Bernard Scott, B.Sc. (Lond.), Ferndale, 81, Babington-road, Streatham, S.W.
1904		Evans, Edward, The Laboratory, South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1891		Evans, Frederick Arthur, The Cape Copper Co., Ookiep, Namaqualand, Cape of Good Hope, South Africa
1876		Evans, Sir John, K.C.B., D.C.L. (Oxon. and Toronto), LL.D. (Dublin and Toronto), Sc.D. (Cantab.), F.R.S., Nash Mills, Hemel Hempstead
1904		Evans, John, F.I.C., 67, Surrey-street, Sheffield
1892	Trans.	‖Evans, Robert Cecil Turle, 9, Heathcote-street, Grays Inn-road, W.C.
1904		Evans, Nevil Norton, McGill University, Montreal, Canada
1888		‖Everard, Arthur George, c/o W. J. Everard, Esq., North-street, Bishop's-Stortford
1902		Everitt, Walter, 83, The Grove, Ealing, W.

Date of Election.			
1894			Evershed, Frank, Kenley, Surrey
1896	Trans.		Ewan, Thomas, M.Sc., Ph.D., c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1902	Trans.		Eynon, Lewis, B.Sc. (Lond.), F.I.C., 57, Darenth-road, Stamford Hill, N.
1901	Trans.		Eyre, John Vargas, 26, Bridge-road-west, Battersea Park, S.W.
1888			Faber, Harald Nicolai, 7 and 8, Idol-lane, E.C.
1905			Fagan, Thomas Wallace, B.A. (Cantab.), Harper Adams Agricultural College, Newport, Salop
1903			Fairhall, Edwin Jesse, A.C.G.I., A.I.C., 8, Scarborough-road, Stroud Green, N.
1865	Trans.		‖Fairley, Thomas, F.R.S.E., F.I.C., 17, East-parade, Leeds
1895			Fairrie, Henry, 253, Vauxhall-road, Liverpool
1899			Fairweather, Ernest Barratt, King's College Hospital, Lincoln's Inn Fields, W.C.
1888			Farlie, John Burke, 54, Wellington-road, Old Charlton, Kent
1903	Trans.		Farmer, Robert Crosbie, M.Sc. (Vict.), Ph.D. (Würzburg), Holmesdale, Pickford-road, Bexley Heath, Kent
1895			Farr, Edward Henry, Uckfield, Sussex
1870			‖Farries, Thomas, F.I.C., 16, Coleman-street, E.C.
1880			‖Farrington, Thomas, M.A. (Q.U.I.), F.I.C., 5, Summerhill-terrace, Wellington-road, Cork
1902			Fasnacht, Eugène Arthur, The Hollies, Clayton Bridge, Manchester
1894			Fawcett, Joseph Addey, 54, Broxholme-lane, Doncaster
1887			Fawsitt, Charles A., 9, Foremount-terrace, Dowanhill, Glasgow
1903	Trans.		Fawsitt, Charles Edward, Ph.D., D.Sc., Chemical Department, The University, Glasgow
1900			Fechtner, Arthur Louis William, 5, Rue de la Porte Rosette, Alexandria, Egypt
1888			Fell, John Campbell, Lansdown Cottage, Ryde, Isle of Wight
1897			Fenby, Alarick Vincent Colpoys, B.Sc. (Lond.), Market Bosworth, Nuneaton
1878	Trans.	C. 1898-1902	‖Fenton, Henry John Horstman, M.A. (Cantab.), F.R.S., F.I.C., Christ's College, and 19, Brook-side, Cambridge
1898			Ferguson, James Edward, Laboratory and Assay Office, 2, Union-court, Old Broad-street, E.C.
1872		C. 1889-93	‖Ferguson, John, Prof., M.A. (Glas.), LL.D. (St. Andrews), F.I.C., The University, Glasgow
1901			Ferguson, Reginald William, B.Sc. (Lond.), A.R.C.S., Municipal Technical School, The Gamble Institute, St. Helens

Date of Election.			
1899			Fermor, Herbert Frederick Francis Burdett, 15, Ansdell-road, Peckham, S.E.
1902			Ferrand, Frederick, 13, Torrington-street, Hopwood, Heywood
1864			‖Ferreira, A. A.
1882			Ferrier, James, Columbus, Georgia, U.S.A.
1905			Ferrier, John Greig, 2, Dalhousie-place, Arbroath, N.B.
1902			Ferrier, John Oliver, Ackland House, Slave Island, Colombo, Ceylon
1902			Ferris, Percy J., Heathfield, Cherry Lane, Lymm, Cheshire
1904			Field, W. Eddington, 65, Sutherland-road, Armadale, Melbourne, Australia
1895			Fielding, Patrick Joseph D., 2, Holmwood-terrace, Southern-road, Cork
1900	Trans.		Findlay, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Leipzig), The University, Birmingham
1905			Findon, Frank Standish, Rev., M.A., B.Sc. (St. Andrews), 41, Great Percy-street, Holford-square, W.C.
1904			Finlow, Robert Steel, B.Sc. (Wales), c/o Messrs. Grindlay and Co., Calcutta, India
1905	Trans.		Finnemore, Horace, A.I.C., 21, Linden Mansions, Highgate, N.
1896			Fisher, Ernest Hunter, The County Laboratory, St. Albans
1872	Trans.		‖Fisher, Walter William, M.A. (Oxon.), F.I.C., 5, St. Margaret's-road, Oxford
1873			Fison, Edward Herbert, Stoke House, Ipswich
1872			Fison, Sir Frederick William, Bart., M.A. (Oxon.), M.P., 64, Pont-street, S.W.
1900			FitzGibbon, Thomas, 14a, Kenyon-street, Fulham, S.W.
1896			Fleet, John Thomas, 24, Sheep-street, Rugby
1899			‖Fleischmann, Friederich Noël Ashcroft, 4, Orme-court, W.
1898			‖Fleming, John Arnold, Britannia Pottery, 136, Glebe-street, Glasgow
1903			Fletcher, Alan, 17, Grove-court, Drayton-gardens, S.W.
1874			Fletcher, Frederick William, North London Chemical Works, Holloway, N., and Beauchamp Lodge, Enfield
1885		C. 1893-4	‖Fletcher, Lazarus, M.A. (Oxon.), F.R.S., Natural History Department, British Museum, Cromwell-road, S.W., and 35, Woodville-gardens, Ealing, W.
1894			‖Flintoff, Robert John, Gale Print Works, Littleborough, Lancs.
1892			Floris, Robert Brooke, F.I.C., Church House, West Hanningfield, near Chelmsford
1894			Fogg, Charles A., "Graythorne," Albert-road, Bolton
1859			Fogg, Thomas, 93, Portsdown-road, Maida Vale, W.
1889			Foggie, John, University College, Dundee
1902			Foll, Edgar, The Cottage, The Lion Brewery, Belvedere-road, Lambeth, S.E.

Date of Election.			
1885			Follows, Harold, 11, Park-avenue, Longsight, Manchester
1894			‖Forbes, Donald Gordon, The Post Office, Victoria, British Columbia
1874			Forbes, James, jun., 70, Gracechurch-street, E.C.
1889	Trans.		Ford, John Simpson, c/o Messrs. W. Younger and Co., Abbey Brewery, Edinburgh
1886			Formoy, James Arthur, Chestham, Grange-road, Sutton
1904			Forrest, James Rocheid, Lieut.-Col., R.A.M.C., D.P.H. (Cantab.), Station Hospital, 18, Camp, Ahmedabad, India
1904			Forrest, John Kerr, Hawsleigh, Balaclava-road, St. Kilda, Victoria, N.S.W.
1893			Forrester, Alexander M., c/o Messrs. Laidlaw, MacKill and Co., Ltd., 3400, Williamsburg-avenue, Richmond, Virginia, U.S.A.
1905			Forster, Ernest Lyle Carman, M.A. (Toronto), Chemical Department, The University, Toronto, Canada
1892	Trans.	C. 1901-04. S. 1904-	‖Forster, Martin Onslow, D.Sc. (Lond.), Ph.D. (Würzburg), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.
1903			Forster, William, 30, Church-street, Seaham Harbour
1856	Trans.	C. 1865-8, 72-5, 85-6 V.P. 88-92	‖Foster, George Carey, Prof., B.A., LL.D., F.R.S., Ladywalk, Rickmansworth, Herts.
1872			Foster, Reginald Le Neve, Bollindene, Wilmslow, Cheshire
1900			Foulds, James, A.R.C.S., 5, Murray-street, Burnley, Lancs.
1898			Foulerton, Alexander Grant Russell, F.R.C.S., L.R.C.P., Haywards Heath, Sussex
1891	Trans.		‖Fowler, Gilbert John, D.Sc. (Vict.), F.I.C., Broad Oak, Urmston, Manchester
1900			Fowler, Morris Broad, 19, Westbury-road, Westbury-on-Trym, near Bristol
1882			‖Fowler, William, M.Sc., 1, Grace-terrace, Sunderland
1895			Fox, A. Stanley, 23, South-road, Faversham
1884			‖Foye, Martin Hugh, M.B., C.M.
1879			Francis, Edward, Ivy Bank, Park-ravine, Nottingham
1902	Trans.		Francis, Francis Ernest, Ph.D. (Erlangen), B.Sc. (Vict.), A.I.C., University College, Bristol
1873			‖Francis, George Bult, 38, Southwark-street, S.E.
1881			Frankland, Henry, F.I.C., Streonshalh, The Crescent, Linthorpe, Middlesbro'.
1880	Trans.	C. 1887-9 V.P. 1902-05	‖Frankland, Percy Faraday, Prof., Hon. LL.D. (St. Andrews), Ph.D. (Würzburg), Hon. M.Sc. (Birm.), B.Sc. (Lond.), A.R.S.M., F.R.S., F.I.C., The University, Birmingham
1867			‖Fraser, Angus, M.A., LL.D., M.D., C.M. (St. Andrews), 232, Union-street, Aberdeen

Date of Election.			
1892			‖Fraser, James C., Mercantile-chambers, Victoria-square, Adelaide, South Australia
1885			Freear, Harry M., Hardwick-road, Woburn Sands, Beds.
1887			Freeman, Frederick William, "Heatherdale," Spenser-road, Harpenden, Herts.
1900			Freeman, Willie Ludford, M.A. (Oxon.), 9, Hamilton-avenue, Chapeltown-road, Leeds
1889			Freestone, Joseph T., Limehurst, Plymyard-avenue, Bromboro', Cheshire
1892	Proc.		French, William, M.A. (Cantab.), F.I.C., Storey Institute, Lancaster
1889	Trans.		Frew, William, Ph.D. (Munich), King James'-places, Perth, N.B.
1903	Trans.		Friend, John Albert Newton, M.Sc. (Birm.), 2, Francis-road, Watford, Herts.
1871	Trans.	C. 1884-9, 92-6	‖Friswell, Richard John, F.I.C., Fairfield, Bexley, Kent
1890			‖Frost, Robert, B.Sc., 55, Kensington-court, Kensington, W.
1904			‖Fry, George, Carlin Brae, Berwick-on-Tweed
1899			Fry, George Cecil, M.Sc. (Vict.), F.I.C., 71, George-street, Saltaire, Shipley, Yorks.
1899	Trans.		Frye, Colin Charlwood, 48, Woodville-gardens, Ealing, W.
1880			‖Fryer, Alfred Cooper, M.A., Ph.D. (Leipzig), F.I.C., 13, Eaton-crescent, Clifton, Bristol
1891			Fulcher, Lionel William, B.Sc., Victoria and Albert Museum, S.W., and "Ingleside," 37, Kempshott-road, Streatham Common, S.W.
1896			Fuller, Charles James Pemeller, 79, Brownlow-road, Horwich, Lancs.
1886			Fuller, John, Rookwood, Montpelier-road, Ealing, W.

1894			‖Gabb, George Hugh, 43, Charlotte-street, Fitzroy-square, W.
1899			Gabriel, Edmund Vivian, M.A. (Cantab.), Ajmere, Rajputana, India
1901			Gadd, Henry Wippell, 27, East Southernhey, Exeter
1901			Gajjar, T. K., Prof., M.A., B.Sc., Gingaum, Bombay, India
1866			Gale, James, M.A., Ph.D., F.G.S., 124, Adelaide-road, South Hampstead, N.W.
1851			‖Gamble, Sir David, Bart., K.C.B., Windlehurst, St. Helens, Lancs.
1876			Gamble, Josias Christopher, Haresfinch, St. Helens, Lancs.
1903			Gandy, William Hunter, Bradley Court, Mitcheldean, Gloucester
1883	Proc.		‖Garbutt, Llewellyn, M.A., The College, Winchester
1903			Gardiner, Ernest Alexander, B.A. (Oxon.), The College, Plymouth

Date of Election.		
1888		Gardiner, James H., 59, Wroughton-road, Balham, S.W.
1905		Gardner, Charles Richard, Green Cottage, Brunswick-square, Gloucester
1901		Gardner, Hermann Charles Thomas, Miller Hospital and Royal Kent Dispensary, Greenwich-road, S.E.
1895		Gardner, James E., 413, Park-road, Oldham
1893	Trans.	Gardner, John Addyman, M.A. (Oxon.), F.I.C., Chemical Department, St. George's Hospital, S.W.
1888		Gardner, Walter M., Prof., Technical College, Bradford, and 3, Fairmount, Manningham, Bradford
1902		Garle, John Longsdon, A.I.C., 136, Holland-road, Kensington, W.
1893	Trans.	Garnett, Henry, 48, Deansgate, Manchester.
1889	Trans.	Garrett, Frederic Charles, M.Sc., Armstrong College of Science, Newcastle-on-Tyne
1898		Garside, Arthur Leonard Harry, B.Sc. (Lond.), A.R.C.S., 6, Cotswold-terrace, Lower Broughton-road, Manchester
1884		Gaskell, Joseph, 71, Haworth's-buildings, Cross-street, Manchester
1900		Gasson, William, Dutoitspan-road, Kimberley, South Africa
1904		Gatehouse, Frank Brooks, The Analytical Laboratory, Broad-street, Bath
1904	Trans.	Gawler, Robert, M.Sc. (Vict.), 3, South View-terrace, Bennett-road, Headingley, Leeds
1887		Geisler, Joseph Frank, Mercantile Exchange Buildings, Hudson and Harrison-streets, New York, U.S.A.
1885		Gemmell, George Harrison, F.I.C., 4, Lindsay-place, Edinburgh
1904		Gent, Percy William, 789, Highland-avenue, Forest Hill, Newark, New Jersey, U.S.A.
1879		‖Gent, William Thomas, Misterton, Gainsborough
1896		George, George, F.I.C., Director of Technical Instruction, Auckland, New Zealand
1904		Gerard, Thomas Alfred, 122, Foxhall-road, Nottingham
1889		‖Gerland, Conrad, M.Sc., Ph.D., Meadow Bank, Accrington
1891		German, George, jun., Mansion House, Ashby-de-la-Zouch
1895		‖Gerrans, Henry Tresawna, M.A. (Oxon.), 20, St. John-street, Oxford
1875		Gerrard, Alfred William, 35, Queen's-road, Wimbledon, S.W.
1899		Getman, Frederick Hutton, 811, Atlantic-street, Stamford, Conn., U.S.A.
1888		Geyzel, John Lawrence Van, Lieut.-Col. I.M.S., F.I.C., Chemical Examiner, Medical College, Madras, India
1904		Ghose, Anukul, 42, Shambazar-street, Calcutta, India
1890		‖Gibbes, Cuthbert Chapman, M.D., C.M. (Aberd.), M.R.C.P. (Lond.), D.P.H. (Cantab.), 89, Harley-street, W.

Date of Election.		
1900		Gibbings, George William, Standard Bank of South Africa, Salisbury, Rhodesia, South Africa
1897		Gibbons, Joseph Lake, The Higher Grade School, Blyth, Northumberland
1900		Gibson, John, St. Oswald's-road, Hexham
1892	Trans.	Gibson, John, Ph.D. (Heidelberg), F.R.S.E., F.I.C., Heriot-Watt College, Edinburgh
1888		Gibson, William Humphrey, 122, King's-road, Brighton
1898		Gidden, William Thomas, The Hawthorns, Moat-road, Langley, near Birmingham
1895		Gilbard, John Francis Hutchins, F.I.C., 245, Dalston-lane, Hackney, N.E.
1904		Gilchrist, James Gray, M.A. (Aberd.), B.Sc. (Lond.), Newseat, Rothienorman, Aberdeenshire
1898		Gilderdale, Frederick, 3, Havelock-street, Newcastle-on-Tyne
1883		‖Gill, E. Clarendon, 10, Barrack-road, Christchurch, Hants.
1888		Gill, John, Gwealhellis, Helston, Cornwall
1902		Gill, J. Arthur, Pennsylvania, Lower-green-road, Rusthall, Tunbridge Wells
1898	Proc.	Gilles, William Setten, F.I.C., The Cottage, Bocking, Braintree, Essex
1905		Gillies, Albert, Government Laboratories, Johannesburg, South Africa
1865		‖Gillman, A. W.
1901		Gillman, Edward, Government Laboratory, Barbados, West Indies
1885		Girdwood, Gilbert Prout, M.D., C.M. (Canada), M.R.C.S. (Eng.), F.I.C., 111, University-street, Montreal
1897		Girtin, Thomas, M.A. (Cantab.), 125A, Highbury New Park, N.
1898		Glaister, John, Prof., M.D. (Glas.), M.R.C.S., L.R.C.P. (Edin.), 18, Woodside-place, Glasgow
1905		Glass, Archibald Melville, B.Sc. (Lond.), 37, Chancery-lane, W.C.
1872		‖Glover, George Thomas, F.I.C., 24, Craven-hill-gardens, Lancaster Gate, W.
1904		Glover, Harry James, Mount Pleasant, Wrattle-road, Westham, near Hastings
1895		Goldfinch, George, 7, Church-walk, Hendon, N.W.
1899		Golding, John, F.I.C., Midland Agricultural and Dairy Institute, Kingston, Derby
1878		Goldschmidt, S. A., Ph.D., c/o Columbia Chemical Works, 43, Sedgwick-street, Brooklyn, New York, U.S.A.
1889		Goldsmith, Byron B., 19, East 74th-street, New York City, U.S.A.
1898		Goldsmith, John Naish, B.Sc., Ph.D., British Xylonite Co., Manningtree, Essex
1899		Goltz, Harold Francis Carl, 155, Brixton Hill, S.W.

Date of Election.			
1897			Gomess, Alfred Francis Bilderbeck, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 33, Drayton-gardens, South Kensington, S.W.
1905			Goodier, Herbert, 16, Hall Royd, Shipley, Yorks.
1904			‖Goodson, John Augustus, A.I.C., 19, Darnley-road, Hackney, N.E.
1890			Goodwin, Thomas Small, Prof., M.B., C.M. (Glas.), F.R.S.E., 54, South-street, Isleworth, Middlesex
1896	Trans.		Goodwin, William, Thorncliffe, Macclesfield
1890			Gordon, Colin, Storer's Wharf, Cubitt Town, E.
1875			Gordon, Joseph Gordon, F.I.C., Queen Anne's Mansions, Westminster, S.W.
1905			Gorman, Henry Isaac, 126, Quay, Waterford, Ireland
1890			Gossling, Frank, B.Sc., H.M. Patent Office, Staple Inn, W.C.
1889	Trans.		‖Gott, Benjamin Scaife, M.A. (Cantab.), The Guildhall, Westminster, S.W.
1903			Gough, Henry, Greenwich Brewery, Greenwich, S.E.
1900			Gough, John Henry, 65, Grange-avenue, Chapeltown-road, Leeds
1879			Gough, Thomas, Rev., B.Sc. (Lond.), King Edward's School, Retford, Notts.
1897	Trans.		Goulding, Ernest, D.Sc. (Lond.), F.I.C., 88, Sylvan Villas, Bowes-park, N.
1887			Gover, Herbert James, 29, Piccadilly, Hanley, Staffs.
1902			Gow, Alexander, Hill Crest, Grappenhall, Cheshire
1889			Gow, Robert J., Ivy Lea, Hough Green, near Widnes
1893			Gower, Alfred Roland, "Ashleigh," Furness Park-road, Barrow
1871	Trans.	C. 1898-1901.	‖Gowland, William, Prof., A.R.S.M., F.I.C., 13, Russell-road, Kensington, W.
1887	Trans.		Goyder, George Arthur, Hawkins-road, Medindie, Adelaide, South Australia
1884			Grace, William Frank, 30, Hartington-villas, Hove, Sussex
1862		C. 1880-1	‖Graham, Charles, D.Sc. (Lond.), F.I.C., The Reculvers, Hastings
1880	Trans.		‖Graham, Christopher Colborne, F.I.C., Oriel House, Scarborough.
1895	Trans.		Graham, Edward, B.Sc., Highcroft, Tilehurst, Berks.
1890	Trans.		Grant, James, F.I.C., 9, Arthur-street, Prestwich, near Manchester
1887			Gravill, Edward Day, F.R.M.S., 42, Walmsley-street, Hull
1882			Gray, George, Canterbury Agricultural College, Lincoln, New Zealand
1900	Proc.		Gray, Robert Whytlaw, 7, Orme-court, Bayswater, W.
1892	Trans.		Gray, Thomas, B.Sc., Ph.D., 204, George-street, Glasgow
1895			Greaves, William Abraham, 20, Beacon-hill-road, Newark
1890			Green, Alfred Henry, A.I.C., Oaklands, Lowton, Newton-le-Willows, Lancs.

Date of Election.			
1885	Trans.	C. 1894-5	‖Green, Arthur George, F.I.C.. Prof., The University, Leeds, and 2, Dartmouth-road, Brondesbury, N.W.
1893			Green, Arthur Henry, Heathfield, St. Anne's-road East, St. Anne's-on-the-Sea, Lancs.
1902	Trans.		Green, Clarence James, B.Sc., c/o Messrs. Nicholson and Co., Beaumont Works, St. Albans
1905			Green, Ernest, 113, Hulton-street, Moss Side, Manchester
1903			Green, George Felix Dudbridge, A.I.C., c/o Messrs. Davey and Co., Gainsboro'-road, Hackney Wick, N.E.
1878			Green, Herbert, Hayle Mill, Maidstone
1887			Green, John Edward, A.R.S.M., Broadlea, Urmston, near Manchester
1878			Green, Lawrence, Lower Tovil, Maidstone
1874	Trans.		‖Greenaway, Alfred John, F.I.C., The Orchard, Chertsey, Surrey
1885			Greenway, Thomas John, F.I.C., The Chillagoe Railway and Mines, Ltd., Chillagoe, Queensland, Australia
1873			Greenwood, William Henry, Birmingham Metal and Munitions Co., Ltd., Adderley Park Works, Birmingham
1894	Proc.		Greeves, Alfred, 25, Balmuir-gardens, Putney, S.W.
1891			Gregory, Alfred John, M.D. (Dur.), M.R.C.S., D.P.H. (Eng.), B.Sc., Colonial Secretary's Office, Cape Town, South Africa
1874			Greville, Henry Leicester, F.I.C., Peniston, 51, Hafton-road, Catford, S.E.
1896			Grice, Walter Thomas, 9, Dalhousie-square, Calcutta, India
1888			‖Griffith, D. Agnew, The Houghlands, Kelsall, Chester
1905			Griffiths, John, B.Sc. (Wales), The Hollies, Upton-park, Chester
1902			Griffiths, John T., The County School, Tenby, S. Wales
1879			Griffiths, Thomas, The Cedars, Clapham Common, S.W.
1895			Grime, Herbert, 3, Hill-side, Lancaster
1903			Grimwade, Wilfrid Russell, B.Sc. (Melbourne), 342–346, Little Flinders-street, Melbourne, Australia Chemical and Gas Department
1880			Grimwood, Robert, F.I.C., Chemical Department, London County Council, 40, Craven-street, W.C.
1893			Grimwood, Robert George, F.I.C., 43, Leaside-avenue, Muswell Hill, N.
1889			Gripper, Harold, Chapel-lane, Wilmslow, Cheshire
1900			Gritton, Henry Bertie, The Cottage, Balmain, Sydney, N.S.W.
1895			Grossman, Edward Henry, 12, Alfred-place-west, South Kensington, S.W.
1871	Trans.	C. 1877-8 V.P. 1899-1902.	‖Groves, Charles Edward, F.R.S., F.I.C., Kennington-green, S.E.
1902			Groves, Samuel Ernest, Ingleside, Bridle-road, South Bolton, Co. Durham

Date of Election.			
1901			Groves, William Peer, B.A. (Cantab.), Green Bank, Plumbley, Cheshire
1897			Grundey, Frederick Roscoe, B.Sc. (Vict.), 33, Woodburn-square, Douglas, Isle of Man
1904			Grundy, Frank Barnes, F.I.C., Victoria Mills, Bredbury, near Stockport
1897			Guest, Edward Graham, M.A. (Cantab.), B.Sc. (Lond.), 5, Churchill, Edinburgh
1903			Gumersall, Edward, 21, New-road, Rochester, Kent
1895			Gunn, Alexander, 13, Wilby-terrace, Fulwich-road, Dartford, Kent
1902			Gunn, Gilbert, 181, Bury-new-road, Summit, Heywood, Lancs.
1899			Gurney, Elliott Henry, Agricultural College, Gatton, Queensland
1898			Guthrie, Alexander, B.Sc., Inglewood, Eaton-road, Coventry
1888	Trans.		Guthrie, Frederick Bickell, F.I.C., Chemical Laboratory, Department of Agriculture, Sydney, N.S.W.
1904			Guthrie, John Monteath, 199, Ferry-road, Leith, N.B.
1904	Trans.		Guttmann, Leo Frank, Ph.D. (Heidelberg), A.I.C., The College of the City of New York, New York City, U.S.A., and 18, Aberdare-gardens, N.W.
1897			Guttmann, Oscar, F.I.C., 12, Mark-lane, E.C.
1902	Trans.		Haas, Paul, B.Sc. (Lond.), Ph.D. (Freiburg), 11, Westbourne-park-road, W.
1874			Habirshaw, William M., Glenwood Works, Yonkers, New York, U.S.A.
1878			‖Hadkinson, John.
1894			Hadley, Arthur, c/o Messrs. Crowley & Co., Ltd., The Brewery, Alton, Hants.
1898			Hadley, E. B., "Dalham Villa," Granville-road, Southfields, S.W.
1893			‖Hadley, Henry Edwin, School of Science, Kidderminster
1886	Trans.		Haga, Tamemasa, D.Sc., College of Science, University of Tokio, Japan
1899			Haigh, Percy, c/o Messrs. Bird Bros., Duxford, Cambridge
1881			Hailes, Alfred James de, F.I.C., 15, Red Lion-square, W.C.
1892			Haines, Walter S., Prof., c/o Rush Medical College, Chicago, U.S.A.
1876	Trans.		Hake, Henry Wilson, Ph.D. (Giessen), F.I.C., Westminster Hospital Medical School, Caxton-street, S.W.
1893			Hale, Henry Ormsby, Oundle School, Northants.
1891	Trans.	C. 1904.	Hall, Alfred Daniel, M.A., Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, Herts.

Date of Election.		
1889		Hall, Allan Twistleton, c/o Messrs. Sipons Bros. and Co., Ltd., Hull
1891		Hall, Archibald, F.I.C., 34, Bishopsgate-street, E.C.
1889	Trans.	Hall, John A., Victoria Chemical Works, Victoria, British Columbia
1903		Hall, John T., West View, Stanwell, Staines
1876		Hall, Samuel, F.I.C., East London Soap Works, Bow, E.
1899		‖Hall, Samuel Godfrey, 19, Aberdeen-park, Highbury, N.
1893		Haller, Albin, Prof., 1, Rue de Goff, Paris
1886		Halliburton, William Dobinson, Prof., M.D., B.Sc. (Lond.), F.R.C.P., F.R.S., Church Cottage, 17, Marylebone-road, N.W.
1897		Halliwell, Edward, F.I.C., c/o Ribble Joint Committee, 2, Stanley-place, Preston
1902		Hallowell, Thomas Butterworth, Ladyshawe House, New Mills, West Stockport
1900		Halstead, Reginald Gordon, 12 and 16, Coleman-street, E.C.
1859		‖Hambly, C. H. Burbridge-, "Fairley," Weston, Bath
1890	Trans.	Hambly, Frederick John, F.I.C., c/o The Electric Reduction Co., Buckingham, Quebec, Canada
1888	Trans.	Hamilton, James C., Arncliffe, Arnside, viâ Carnforth
1898		Hamilton, Oswald, Old Stratford, Stony Stratford, Bucks.
1897		Hamilton, Robert, 3, Westminster-terrace, Ibrox, Glasgow
1875	Trans.	Hamlet, William Mogford, F.I.C., Government Laboratory, Macquarie-street, Sydney, N.S.W.
1904		Hammond, Harold Sankey, Ontario Agricultural College, Guelph, Ontario, Canada
1901		Hammond, Herbert Blackmore, 41, St James'-street, Dover
1857		Hanbury, Cornelius, F.I.C., Plough-court, Lombard-street, E.C., and Dynevor House, Richmond, Surrey
1900		Handcock, Walter Augustus, A.I.C., Pentlands, 39, The Avenue, Beckenham, Kent
1895	Trans.	Hanes, Edgar Septimus, F.I.C., 34, Keyes-road, Cricklewood, N.W.
1896		Hanger, Ralph Hamilton, Hawthorn-villa, Newland, Hull
1900		Hanley, John, F.I.C., 32, Wentworth-avenue, New Brighton, Cheshire
1902	Trans.	Hann, Archie Cecil Osborn, 54, Wood-vale, Forest Hill, S.E.
1872	Trans.	‖Hannay, James Ballantyne, F.I.C., Cove Castle, Loch Long, N.B., and Whitehall Club, S.W.
1889		‖Hanson, Alfred Miall, The Abbey Print Works, Whalley, near Blackburn
1901	Trans.	Hanson, Edward Kenneth, M.A. (Cantab.), A.I.C., Mapledene, Hadley Wood, N.
1895		Hanson, Weldon, Fairleigh, Clairmont-terrace, Norton, Stockton on-Tees

Date of Election.			
1897			Harbord, Frank William, F.I.C., Surbiton House, Englefield Green, Surrey
1859	Trans.	S. 1865-73 V.P. 73-6 80-3, 92-5 P. 1895-7	‖Harcourt, Augustus George Vernon, M.A. (Oxon.), Hon. D.C.L. (Dun.), Hon. LL.D. (Montreal), F.R.S., F.I.C., St. Clare, Ryde, Isle of Wight
1863			‖Harcourt, Leveson Francis Vernon, M.A. (Oxon.), M.I.C.E., Haddon House, Weybridge
1887	Trans.	C. 1902-05	‖Harden, Arthur, D.Sc. (Vict.), Ph.D. (Erlangen), F.I.C., 2, Marlborough-road, Richmond, Surrey
1902			Harding, Herbert, B.Sc. (Lond.), 47, Streathbourne-road, Upper Tooting, S.W.
1885			Hards, William Benjamin, B.A., Board of Education, South Kensington, S.W.
1892			Hardy, James Gordon, c/o The Creston Colorado Mining Co., Torres Sonora, Mexico
1898			Hargreaves, A. F., Esk Hill, Rosslyn, Midlothian
1876			Hargreaves, James, Peel House-lane, Farnworth, near Widnes
1884			Hargreaves, John, F.I.C., Widnes, Lancs.
1901			Hargreaves, William Arthur, M.A., B.C.E. (Melbourne), F.I.C., Government Analyst, Adelaide, S. Australia
1901			Harker, George, D.Sc., 35, Boulevarde, Petersham, Sydney, N.S.W.
1876			‖Harland, Robert Henry, F.I.C., 37, Lombard-street, E.C.
1878			‖Harland, William Dugdale, 48, King-street, Manchester
1897			Harley, Vaughan Berkeley, Prof., M.D., 25, Harley-street, W.
1874			‖Harman, Frederick Edwin, c/o Dr. Piggott, 13, Orchard-gardens, Teignmouth, Devon
1897			Harman, Harold W., 70, Upper Tulse Hill, S.W.
1903			Harmer, Francis Gerald, Middle Class School, Vernon-road, Leeds
1905			Harold, Frederick Clarkson-, 23, Chesnut-grove, Birkenhead
1899			Harper, Henry William, M.D. (Va.), The University of Texas, Austin, Texas, U.S.A.
1897			Harrie, Harold William, c/o Messrs. Harker, Stagg and Morgan, 15, Lawrence Pountney-lane, E.C.
1897			Harrington, B. J., Prof., M.A., Ph.D., McGill University, Montreal, Canada
1896			Harrington, William, 9, Edgehill-terrace, Bransby, Whitehaven
1881			Harrington, William Bury, Leeview, Montenotte, Cork
1896			Harris, Frederick William, Sanitary Chambers, Glasgow
1893			Harris, Harold, Rouse Lench, Kingsholm, Gloucester
1895			Harris, Harry, c/o The Hall Mining and Smelting Co., Nelson, British Columbia
1874			Harris, Henry Penley, 8, Howard-road, Cricklewood, N.W.
1894			Harris, Sydney Walters, Devon House, Walter-road, Swansea

Date of Election.			
1878			‖Harris, Thomas Frederick, B.Sc., Waterford House, Aylsham, Norfolk
1895			Harris, Walter, M.A. (Cantab.), B.Sc. (Lond.), Ph.D. (Heidelberg), Sutherland Institute Technical School, Longton, Staffs.
1888			‖Harrison, Albert, Delamere, Grove-road, South Woodford, Essex
1894	Trans.		Harrison, Edward Frank, B.Sc. (Lond.), F.I.C., 2, Charterhouse-street, E.C., and Langholm, Purley Oaks-road, S. Croydon
1883			‖Harrison, Hugh Erat, B.Sc., 28, Sussex-place, Regent's Park, N.W., and Faraday House, Charing Cross-road, W.C.
1901			Harrison, John Ansted, B.Sc., Brayton House, Wellington-row, Whitehaven
1888			Harrison, John Burchmore, C.M.G., M.A. (Cantab), F.I.C., Government Laboratory, George Town, Demerara, British Guiana
1902			Harrison, Walter Ernest, 15, Lansdowne-road, Handsworth, Birmingham
1891			Harrold, Frederick William, South Bank, Elmstead-lane, Chislehurst
1876	Trans.		Harrow, George Harrow Unwin, Ph.D. (Würzburg), F.I.C., Messrs. Allsopp and Sons' Brewery, Burton-on-Trent
1901			Harry, Frederick Thomas, 106, Sandmere-road, Clapham Common, S.W.
1886			Hart, Bertram Harvey, The Elms, Old Charlton, Kent, S.E.
1869			‖Hart, F. W., Holly House, 96, Stoke Newington-road, N.
1900			Hart, Herbert William, 5, Cambridge-road, Ansdell, Lytham, Lancs.
1891			Hart, William Beamont, F.I.C., Laboratory, 8, Exchange-street, Manchester
1882			Hartley, Arthur, The Brewery, Emsworth, Hants.
1897			Hartley, Ernald George Justinian, B.A. (Oxon.), The Bungalow, Foxcombe Hill, near Oxford
1899			Hartley, Harold Brewer, B.A. (Oxon), Balliol College, Oxford
1897			Hartley, Thomas, B.Sc. (Lond.), F.I.C., Swindon and North Wilts. Technical School, Swindon
1866	Trans.	C. 1877-80 V.P. 90-3	Hartley, Walter Noel, Prof., D.Sc. (R.U.I.), F.R.S., F.R.S.E., F.I.C., Royal College of Science, Stephen's-green, and 36, Waterloo-road, Dublin
1890	Trans.		Hartog, Philip Joseph, B.Sc., 22, Brondesbury-villas, N.W.
1900	Trans.		Hart-Smith, James, A.R.C.S., F.I.C., 4, Grafton-mansions, Venn-street, Clapham, S.W.
1900	Trans.		Harvey, Alfred William, 13, Pendrell-road, St. Catherine's Park, Hatcham, S.E.
1885			Harvey, Ernest William, A.R.S.M., Stoneleigh, 23, Grove-road, Clapham Park, S.W.

Date of Election.			
1881			Harvey, Sidney, F.I.C., Canterbury
1894			Harvey, W. Pellew, 31, Walbrook, E.C.
1894			Hatfield, John Adams, F.I.C., c/o Messrs. J. Lysaght, Ltd., Orb Iron Works, Newport, Mon.
1892			Hatton, William Percy, c/o Messrs. W. R. Hatton and Sons, Wormwood Scrubs, W.
1880			Hawkes, Alfred Edward, M.D. (Brussels), L.R.C.P. (Edin.), 22, Abercromby-square, Liverpool
1894	Trans.		Haworth, Edward, D.Sc., Sunnyside, Norman-road, Runcorn, Cheshire
1898			Haworth, John, 17, Knaresboro'-road, Millhouses, near Sheffield
1905	Trans.		Hawthorne, John, 7, Roseneath-villas, Military-road, Cork
1900			Haynes, James Herbert, B.Sc. (Vict.), Essendene, Seymour-road, Ashley Down, Bristol
1903			Heasman, Harold Montague, 2, Broadway, Westminster, S.W.
1891			Heath, John William, 33, Upper Gloucester-place, W.
1898			Heaton, John, Southcliffe, Roker, Sunderland
1902			Heaton, Noël, B.Sc. (Lond.), 20, Baker-road, Harlesden, N.W.
1899			Hedley, George Ward, M.A. (Oxon.), 2, St. Luke's-terrace, Cheltenham
1905			Heely, Frederick William, 10, Yarborough-street, Grimsby
1876		C. 1895-9	Hehner, Otto, F.I.C., 11, Billiter-square, E.C.
1889			Helbing, H. B., 63, Queen Victoria-street, E.C.
1875			‖Hellon, Robert, Ph.D. (Heidelberg), A.R.S.M., F.I.C., Whinthwaite, Seascale, viâ Carnforth
1872			‖Helm, Henry James, I.S.O., F.I.C., Simonstone, 27, Hammelton-road, Bromley, Kent
1894			Helms, Albert, M.A., Ph.D., 8, Bridge-street, Sydney, N.S.W.
1896			Helps, James William, 3, Tavistock-road, Croydon
1899			Hembrough, James, A.R.C.S., A.I.C., 7, Park-view, Beeston Hill, Leeds
1900			Hemingway, Frank Christian Richard, 133, Front-street, New York City, U.S.A.
1898	Trans.		Hemmy, Arthur Stanley, Prof., B.A., M.Sc., Government College, Lahore, India
1885	Trans.		‖Henderson, George Gerald, Prof., M.A., D.Sc. (Glasgow), F.I.C., The Technical College, 204, George-street, Glasgow
1895	Trans.		Henderson, James, B.Sc. (St. Andrews), Ph.D., c/o Messrs. Horlick and Co., Racine, Wisconsin, U.S.A.
1905			Henderson, James Alexander Russell, Prof., B.Sc. (Glasgow), Chihli Provincial College, Paotingfu, North China
1900	Trans.		Henderson, John Brownlie, F.I.C, Government Analyst, Brisbane, Queensland

Date of Election.			
1892			Hendrick, James, B.Sc. (Lond.), F.I.C., Marischal College, Aberdeen
1904			Hendrickson, Arthur V., The Gas Works, Lower Sydenham, S.E.
1901			‖Henley, The Hon. Francis Robert, M.A. (Oxon.), A.I.C., 6, Melville-street, Edinburgh
1905			Hennings, Carl Richard, Ph.D. (Freiburg), 19, St. Dunstan's Hill, E.C.
1899	Trans.		Henry, Thomas Anderson, D.Sc. (Lond.), 70, Doneraile-street, Fulham, S.W.
1905	Trans.		Henstock, Herbert, B.Sc. (Vict.), Ph.D. (Zürich), Greenfield, Huxley, near Chester
1904			Henzell, Archie Willoughby, Orphan Working School, Haverstock Hill, N.W.
1853			Hepburn, J. G., LL.B., Dartford, Kent
1895			Heriot, Thomas Hawkins Percy, 37, Church-crescent, Muswell Hill, N.
1871			Herman, Douglas, F.I.C., Rainhill, Lancs.
1876	Trans.	C. 1892-3	Heron, John, B.E. (R.U.I.), F.I.C., 110, Fenchurch-street, E.C.
1905			Hetherington, Arthur Lonsdale, B.A. (Cantab.), Government Collegiate School, Rangoon, Burma
1892	Trans.	C. 1903-05	Hewitt, John Theodore, M.A., D.Sc., Ph.D., 8, Montpelier-road, East Twickenham
1900			Hewitt, Samuel, 51, Dover-street, Norwich
1892			Hewlett, John C., 40, Charlotte-street, Great Eastern-street, E.C.
1883	Trans.	C. 1897–1901.	‖Heycock, Charles Thomas, M.A. (Cantab.), F.R.S., 24, Fitzwilliam-street, Cambridge
1890			Heywood, Joseph H., 231, Drake-street, Rochdale
1848			Heywood, J. S. C., Export Department, Storer's Wharf, Poplar, E.
1876	Trans.		Hibbert, Walter, F.I.C., 144, Walm-lane, Willesden Green, N.W.
1894			Hichens, James Harvey, M.A. (Oxon.), F.G.S., The School House, Wolverhampton
1881			‖Hiddingh, Michael, Newlands, near Capetown, South Africa
1901			Higgs, Henry Herbert, B.Sc. (Lond.), "Ivanhoe," Highbridge-road, Wylde Green, Birmingham
1894			Higgs, Martin Stanger, Southern Main Reef Estates, Ltd., Mine Office, Venterskroon, Transvaal, South Africa
1882			‖Hill, Alexander.
1896	Trans.		Hill, Arthur Croft, M.A., M.D., B.S., (Cantab.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 169, Cromwell-road, S.W.
1896			‖Hill, Charles Alexander, B.Sc. (Lond.), F.I.C., 15, Brunswick-gardens, Kensington, W.

Date of Election.			
1896	Proc.		Hill, Ernest George, Prof., B.A. (Oxon.), Muir College, Allahabad, India
1897			Hill, Sydney, c/o Messrs. Blundell, Spence and Co., Ltd., Hull
1894			‖Hills, Edmond Herbert, Capt. R.E., 32, Prince's-gardens, London, S.W.
1892			‖Hills, Harold F., Commercial Gas Works, Stepney, E.
1898			Hills, Thomas Herbert, 6, Eliot Park, Blackheath, S.E.
1873			‖Hills, Walter, 225, Oxford-street, W.
1896			Hinchley, John William, A.R.S.M., Royal Mint, Bangkok, Siam
1903			Hindmarsh, Leonard King, B.A. (Oxon.), The Grammar School, Sutton Coldfield, near Birmingham
1900			Hinks, Percy John, A.R.C.S., F.I.C., "Woodstock," Beaconsfield-road, Blackheath, S.E.
1894			Hirsch, Charles Theodore William, M.D., M.R.C.S. (Eng.), L.R.C.P. (Lond.), Charlinch, Rectory-road, Woolwich, S.E.
1870			Hislop, George Robertson, Gasworks, Blackstoun-road, Paisley
1898			‖Hislop, Lawrence, Gasworks, Uddingston, Glasgow
1898			Hislop, Robert Findlay, Craigielea, Paisley
1883			‖Hobbs, Bedo, Lamb Brewery, Chiswick, W.
1901			Hobson, Edwin, Howdendyke, Howden, Yorks.
1884			Hodges, Herbert John, 224, The Rye, Peckham, S.E.
1882	Trans.		‖Hodgkin, John, F.I.C., F.L.S., 97, Hamlet-gardens-mansions, Ravenscourt Park, W.
1879	Trans.	C. 1883-5	Hodgkinson, William Richard Eaton, Prof., Ph.D. (Würzburg), F.I.C., F.R.S.E., 18, Glenince-road, Blackheath, S.E.
1886			Hodgson, Christopher, 33, Oakdale-road, Netheredge, Sheffield
1898			Hodgson, Harry McAlpin, Foxhill Bank Print Works, Church, near Accrington
1873			‖Hodgson, Henry Tylston, M.A. (Cantab.), Harpenden, Herts.
1904			Hodgson, Thomas Reginald, B.A. (Cantab.), 15, Canonbury-square, Highbury, N.
1885			Hogg, Edward Grindle, 1, Southwick-street, Hyde Park-square, W.
1883			Hogg, W. Douglas, M.D. (Paris), 62, Champs Elysées, Paris
1904			Hoit, Alfred Henry, 4, Montgomerie-road, Southsea
1876			Holcroft, Harold, M.A., Parkdale, Wolverhampton
1901			Holdcroft, George Frederick, 16, De Gray-street, Beverley-road, Hull
1885			Holgate, Thomas, 5, Victoria-street, Westminster, S.W.
1876			Holland, Philip, F.I.C., 22, Taviton-street, Gordon-square, W.C.
1903			Hollingworth, David Vincent, 3, Adelphi-terrace, Crescent, Salford
1891			Holloman, Frederick R., Southern-road, Plaistow, E.
1886			Holloway, George Thomas, A.R.C.S., F.I.C., 57 and 58, Chancery-lane, W.C.

Date of Election.			
1895			Holme, Arthur Edward, M.A. (Oxon.), The Wheelwright Gramma School, Dewsbury
1897	Trans.		Holmes, John, F.I.C., Government Laboratory, Clement's In Passage, W.C.
1898	Trans.		Holroyd, George William Fraser, B.A., 1, Carlton-gardens, Ealing W.
1902	Trans.		‖Holt, Alfred, jun., B.A., Crofton, Aigburth, Liverpool
1893			Holthouse, Harold B., 12, Melton-grove, West Bridgford, Notts
1898			Homfray, David, B.Sc. (Lond.), F.I.C., 6, Dartmouth-row Greenwich, S.E.
1878			Hooker, Ayerst Henham, F.I.C., Board of Health, Cairo, Egypt
1892	Trans.		Hooker, Samuel C., 4422, Chestnut-street, Philadelphia U.S.A.
1883			‖Hooper, David, F.I.C., Curator, Economic and Art Section, India Museum, 1, Sudder-street, Calcutta, India
1888			‖Hooper, Egbert Grant, F.I.C., 16, Royal-avenue, Sloane-square S.W.
1891			‖Hooper, Ernest F., Wear Fuel Works, South Dock, Sunderland
1902			Hopwood, Arthur, A.R.C.S., A.I.C., 49, Stanley-street, Tunstall Stoke-on-Trent
1904			Horn, George Mathieson, Ivylands, Epping, Essex
1894			‖Hornby, Richard, M.A. (Oxon.), Haileybury College, Hertford
1905			Horrod, George William Thomas, 294, Brixton Hill, S.W.
1897			Horseman, James Walter, County School, Bedford
1892			Horsfall, John, 4, Grange-avenue, Rawtenstall, Manchester
1901	Proc.		Horton, Edward, 8, Orford-street, Chelsea, S.W.
1892			Horwill, Edgar Edward C., 6, Devereux-road, New Wandsworth S.W.
1903			Hosking, Arthur Francis, c/o The Aruba Gold Concession, Ltd. Aruba Island, Dutch West Indies, viâ Curaçao
1886			‖Hoskins, Arthur Percy, F.I.C., Clonlee, Rosetta Park, Belfast
1871			Houlder, William Washington, North Hyde House, Southall
1901			Houldershaw, Arthur, 4, Beacon-street, Low Fell, Gateshead-on-Tyne
1887	Proc.		Houlding, William, B.Sc., Arisaig, Aigburth Drive, Liverpool
1900			Houston, Adam, Brisbane House, Bellahouston, Glasgow
1896			Howard, Albert, South Eastern Agricultural College, Wye, Ken
1882			‖Howard, Alfred G., Burnt House, Chigwell, Essex
1901			Howard, Bernard Farnborough, A.I.C., Devon House, Buckhurs Hill, Essex
1870		C. 1875-9, 83-5, 98-1902. V.P. 1886-9, 1903-	‖Howard, David, F.I.C., Devon House, Buckhurst Hill, Essex
1887	Trans.		‖Howard, David Lloyd, jun., Little Friday Hill, Chingford, Esse

Date of Election.		
1889		Howard, George William, Calverley, Tunbridge Wells
1875		Howard, Thomas, F.I.C., 50, Ellington-street, Liverpool-road, N.
1904		Howarth, John George, "Danes Dyke," Lowther-road, Bournemouth
1882		Howe, J. Lewis, Prof., M.D., Ph.D. (Göttingen, B.A. (Mass.), Washington and Lee University, Lexington, Va., U.S.A.
1898		Howe, Walter, 5, Blenheim-road, Bradford
1880		Howell, Reginald, 95A, Southwark-street, S.E.
1905		Howgate, James Henry, B.A. (Lond.), The Grammar School, Huntingdon
1876		Howie, William Lamond, Hanover Lodge, West Hill, Harrow
1903		Howorth, Franklin Wise, 46, Lincoln's Inn Fields, W.C.
1889		‖Hoyle, Richard Ashworth, Elm-grove, Fairlawn-road, Lytham, Lancs.
1889		Hoyles, Henry Richardson, 10, Fore-street, Wellington, Somerset
1871		‖Hudleston, Wilfrid Hudleston, M.A. (Oxon.), F.R.S., 8, Stanhope-gardens, S.W.
1900		Hudson, Edmund Foster, B.A. (Cantab), Churcher's College, Petersfield, Hants.
1878		Hudson, William, B.Sc. (Lond.), The Lilies, Twickenham
1899		Hübner, Julius, F.I.C., Ash-villa, Cheadle Hulme, Cheshire
1901		Hughes, Edward, Rev. Canon, The Rectory, Barmouth
1903		Hughes, Edwin Reginald, 106, Queen Victoria-street, E.C.
1894	Trans.	Hughes, Frank, c/o Khedivial Agricultural Society, P.O. Box 63, Cairo, Egypt
1880	Trans.	Hughes, George Henry, 155, Fenchurch-street, E.C.
1868		Hughes, John, F.I.C., Analytical Laboratory, 79, Mark-lane, E.C.
1896		Hughes, Joshua Arthur, 1, Bridewell-street, Bristol
1885		Hughes, Theophilus Vaughan, A.R.S.M., F.I.C., 26, Barnsley-road, Edgbaston, Birmingham
1882		Hughes, Thomas, F.I.C., Borough Analyst's Office, 31, Loudoun-square, Cardiff
1904		Hulme, John, 5, Duke-street, Macclesfield
1883		Humphrys, Norton Henry, 4, The Paragon, Wilton-road, Salisbury
1869		Hunt, Charles, 15, Victoria-street, Westminster, S.W.
1899		Hunter, Archibald Glen Kidston-, Public Analyst, 132, Princes-street, Dunedin, New Zealand
1883		Hunter, John, F.I.C., 37, Chambers-street, Edinburgh
1885		Hunter, Matthew, M.A. (Oxon.), Rangoon College, Rangoon, Burma
1878		Huntington, Alfred Kirby, Prof., A.R.S.M., F.I.C., Metallurgical Laboratory, King's College, Strand, W.C.
1893	Trans.	Huntly, George Nevill, B.Sc. (Lond.), A.R.C.S., F.I.C., 96, Gower-street, W.C., and 56, Sheen-road, Richmond

Date of Election.		
1885		Hurst, George H., 22, Blackfriars-street, Salford
1902	Trans.	Hurtley, William Holdsworth, D.Sc. (Lond.), St. Bartholomew's Hospital, E.C.
1861		Huskisson, Henry Owen, F.I.C., 5, Gordon-square, London, W.C.
1900		Hutchin, Henry William, Basset-road, Camborne, Cornwall
1894		Hutchinson, Alfred, M.A. (Cantab.), B.Sc., Bryn-y-Mor, Saltburn-by-the-Sea
1890	Trans.	‖Hutchinson, Arthur, M.A. (Cantab.), Ph.D., Pembroke College, Cambridge
1884		‖Hutchinson, Christopher Clarke, F.I.C., 13, The Boltons, South Kensington, S.W.
1901		Hutton, Robert Salmon, D.Sc. (Vict.), The University, Manchester
1903		Hnyin, Moung Tha, B.A. (Calcutta), Barrister-at-Law, Moulmein, Burma
1901		Hyder, Alfred James, 22, Gunton-road, Upper Clapton, N.E.
1904		Hymans, Herbert, 13 and 14, Trinity-square, E.C.
1900		‖Ichioka, Tajiro, Prof., 19, Maruyama Shinmachi, Hongo, Tokio, Japan
1888		Idris, Thomas Howell Williams, 110, Pratt-street, Camden Town, N.W.
1867		‖Ince, Joseph, Glenholme, 13, Alfred-road, Acton, W.
1889	Trans.	‖Ingle, Herbert, F.I.C., Government Agricultural Chemist, Pretoria, Transvaal, South Africa
1904		Inglis, John Kenneth Harold, M.A., B.Sc. (N.Z.), B.Sc. (Edin.), University College, Gower-street, W.C.
1901		Ingram, Beresford, William Ellis Endowed School, Gospel Oak, N.W.
1897	Trans.	Innes, William Ross, Ph.D. (Heidelberg), D.Sc. (Vict.), F.I.C., 6, Griffiths-road, Wimbledon, S.W.
1901		‖Ionides, Stephen Archigenes, 23, Second-avenue, Hove, Sussex
1883		‖Irwin, Wilfred, Inglehurst, Higher-lane, Stand, Manchester
1892		‖Isaac, John F. V.
1885		Ivatt, Albert, M.A. (Cantab.), "The Engadine," Histon, Cambridge
1894		Jackman, Edwin James, 60, Belgrave-road, Ilford, Essex
1883		‖Jackson, Alfred Henrick, Prof., B.Sc., The Electrical Engineering School, 349, Collins-street, Melbourne, Australia

Date of Election.			
1903			Jackson, Clements Frederick Vivian, F.G.S., Geological Survey Office, Perth, Western Australia
1894	Trans.		Jackson, David Hamilton, M.A. (N.Z.), B.Sc., Ph.D. (Heid.), 54, Croftdown-road, N.W.
1882			Jackson, Edward, F.I.C., "Raven's Clift," Oxford-road, Moseley, Birmingham
1900	Trans.		Jackson, Henry, M.A. (Cantab.), Downing College, Cambridge
1884	Trans.		Jackson, Herbert, F.I.C., Chemical Laboratory, King's College, Strand, W.C.
1881			‖Jackson, Ransford Valentine, B.A. (Oxon.), c/o The Scotch and Irish Oxygen Company, Polmadie, Glasgow
1892			Jackson, Samuel, A.R.C.S., F.I.C., c/o Messrs. Binny and Co., Madras, India
1902			Jackson, William Brannan, Glengowan, Caldercruix, N.B.
1903			Jackson, William Henry, 73, Church-street, West Hartlepool
1887			‖Jadhava, Khasberao B., Nawasari, Bombay Presidency, India
1900			Jaffé, Adolf, 8, Leyburn-grove, Shipley, Yorks.
1878	Trans.		Jago, William, F.I.C., 3, Crown Office-row, Temple, E.C., and 17, Wilbury-avenue, Hove, Sussex
1895			James, Alfred, 2, Broad-street-place, E.C.
1904			James, Thomas Campbell, B.A. (Cantab.), B.Sc. (Wales), University College of Wales, Aberystwith
1904			James, Walter Richmond, 49, Wednesfield-road, Wolverhampton
1878			Jamieson, Alexander, 134, Castellain-mansions, Sutherland-avenue, W.
1901			Jamieson, J. S., Government Laboratory, Durban, Natal
1879	Trans.	C.1882-5 F.S. 85-91 V.P.95-9	†‖Japp, Francis Robert, Prof., M.A., Hon. LL.D. (St. Andrews), F.R.S., F.I.C., The University, Aberdeen
1902			Jardin, David Smith, A.R.C.S., F.I.C., Rathgar House, Rathgar, Co. Dublin
1902			Jardine, Douglas Kennedy, B.Sc. (Vict.), c/o Daily Chronicle Office, Georgetown, Demerara, British Guiana
1882			Jarmay, Gustav, F.I.C., Hartford Lodge, Hartford, Cheshire
1905			Jarrard, William John, B.Sc. (Lond.), A.R.C.S., The University, Sheffield
1898			Jarvis, George Arthur, The Shrubbery, Snedshill, Wellington, Salop
1898			Jee, Edwin Charles, D.Sc. (Lond.), F.I.C., 39, Pepys-road, New Cross, S.E.
1896	Proc.		Jeffers, Ernest Haynes, 87, Kyrle-road, West Side, Clapham Common, S.W.
1901	Proc.		Jemmett, William Henry Coutts, M.A. (Cantab.), Tintern, Gap-road, Wimbledon, S.W.

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† Longstaff Medallist, 1891.

Date of Election.		
1891	Trans.	Jenkins, Henry Charles, 5, Deerbrook-road, Herne Hill, S.E.
1904		Jenkins, Herbert, 15, Old Bond-street, Bath
1892		‖Jenkins, John H. B., Chemical Laboratory, Great Eastern Railway Works, Stratford, E.
1894		Jenks, Robert Leonard, A.C.G.I., F.I.C., 20, Drakefield-road, Upper Tooting, S.W.
1900		Jennings, Henry, 42, Marlowes, Hemel Hempstead, Herts.
1904		Jennings, Walter Ernest, 8, Rawdon-terrace, Ashby-de-la-Zouch
1894		Jennison, Francis Herbert, F.I.C., 26, Derby-crescent, Kelvinside, near Glasgow
1897	Trans.	‖Jerdan, David Smiles, M.A. (Glas.), B.Sc. (Vict.), Ph.D., c/o Messrs. J. and G. Cox, Gorgie Mills, Edinburgh
1898		Jessop, Samuel Morton, 84, Horbury-road, Wakefield
1879		Jewson, Francis Albert Bowen, F.I.C., 19A, Devonshire-place, Brighton
1901		Johnson, Charles Harold, M.D., C.M., F.R.C.S., M.R.C.P. (Edin.), "Beaumont," Northcote, Melbourne, Australia
1895		Johnson, Frederick Edward, Holly House, Cottingham, Hull
1897	Trans.	Johnson, Harold, D.Sc. (Brussels), 5, Avington-grove, Penge, S.E.
1883		Johnson, James Edward, F.I.C., 40, Idmiston-road, Stratford, E.
1872		Johnson, John Grove, 23, Cross-street, Finsbury, E.C.
1904		Johnson, John Richard, 11, Church-hill, Walthamstow, E.
1886		Johnson, John Tysilio, Durham School, Durham
1897		Johnson, Otis C., Prof., 730, Thayer-street, Ann Arbor, Mich., U.S.A.
1866		‖Johnson, Samuel H., The Warren Hill, Loughton, Essex
1904		Johnston, John Haslam, M.Sc. (Vict.), F.I.C., Public Offices, Hampton, Middlesex
1896		Johnstone, James, F.I.C., Braehead, Parkhill, Rutherglen
1892		Johnstone, William George, c/o Thomas Manwell, Esq., 8, Great Winchester-street, E.C.
1901	Trans.	Jollyman, Walter Henry, F.I.C., P.O. Box 3782, and Government Laboratory, P.O. Box 1080, Johannesburg, Transvaal, South Africa
1903		Jones, Alfred Owen, c/o Messrs. Carr & Co., Caldewgate, Carlisle
1905		Jones, Bernard Mouat, B.A. (Oxon.), Alcala, 2, Hermitage-road, Upper Norwood, S.E.
1898		Jones, Edward, B.Sc. (Lond.), F.I.C., 15, Macaulay-road, Clapham, S.W.
1871	Trans.	Jones, Edward William Taylor, F.I.C., The Oaklands, and 10, Victoria-street, Wolverhampton
1873	Trans.	Jones, Francis, M.Sc., F.R.S.E., Beaufort House, Alexandra-park, Manchester

Date of Election.		
1894		‖Jones, George Cecil, A.C.G.I., F.I.C., Stour-villa, Mistley, Essex
1876	Trans.	‖Jones, Henry Chapman, F.I.C., Royal College of Science, South Kensington, S.W.
1893		Jones, Hedley Gordon, F.I.C., 32, Beechhill-road, Eltham, S.E.
1900	Trans.	Jones, Humphrey Owen, M.A. (Cantab.), D.Sc. (Lond. and Wales), Clare College, Cambridge
1878		Jones, Henry Williams, Spencer-park, Coventry
1905		Jones, Horace Francis, 7, Marlborough-avenue, Reading
1890		Jones, John Archyll, B.Sc., 2, Stanhope-avenue, West Hartlepool
1901		Jones, John Lloyd Thomas, Major, I.M.S., Byculla Club, Bombay
1892	Trans.	Jones, Lionel Manfred, Municipal Technical School, Suffolk-street, Birmingham
1899		Jones, Lauder William, A.B. (Williams Coll.), Ph.D. (Chicago), University of Chicago, Chicago, Ill., U.S.A.
1891		Jones, Moses William, Greystonedale, Kensington-hill, Brislington, Bristol
1905		Jones, Percy Walter, Toowong, Brisbane, Queensland
1896		Jones, Robert Haslewood, 88, Norwood-road, London, S.E.
1901		Jones, Robert Henry, M.Sc. (Vict.), The Harris Institute, Preston
1898		Jones, Thomas Hill-, Invicta Mills, Bow-common-lane, E.
1905		Jones, Tudor Foulkes, B.Sc. (Wales), Chatham House, Ramsgate
1905		Jones, William App., A.M. (N.C.), Ph.D. (Baltimore), c/o The Boston Artificial Leather Co., Ludlow and Canal-street, Stamford, Conn., U.S.A.
1904	Trans.	Joseph, Alfred Francis, A.R.C.S., 95, Marylands-road, Maida Vale, W.
1893	Trans.	Jowett, Hooper Albert Dickinson, D.Sc. (Lond.), 'Wansfell,' Church-avenue, Sidcup, Kent
1891		Jowett, William Hall, 3 and 5, Concert-street, Liverpool
1900		Joyce, Thomas Goode, B.Sc. (Lond.), F.I.C., 41, Britannia-row, Islington, N.

1893		Káká, Sorabji Manekji, Devon Villa, Karachi, Sind, India
1886	Trans.	Kawakita, Michitada, Engineering College, Tokio, Japan
1905	Trans.	Kay, Sydney A., D.Sc. (St. Andrews), United College, St. Andrews, N.B.
1881	Trans.	Kay, William Edward, Marple Lodge, Marple, Cheshire
1889		Kaye, James Robert, M.B., M.Ch. (Glas.), Medical Officer of Health, West Riding of Yorkshire, Wakefield

Date of Election.			
1886	Trans.	C. 1903-5	Keane, Charles Alexander, Ph.D. (Erlangen), M.Sc. (Vict.), F.I.C., The Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C.
1883			‖Keeling, Frank, c/o David Stevenson Brewing Co., 521, Tenth-avenue, New York, U.S.A.
1882			‖Keen, Austin, Cefn Llys, Bentley-road, Cambridge
1894			‖Kellas, Alexander Mitchell, B.Sc., 2, St. Mark's-square, Regent's Park, N.W., and Chemical Dept., Middlesex Hospital Medical School, W.C.
1874			Kellner, William, Ph.D. (Göttingen), F.I.C., Chemical Department, Royal Arsenal, Woolwich, S.E., and 135, Victoria-road, Old Charlton, Kent
1897			Kelly, Charles, The Technical School, Darwen, Lancs.
1867			‖Kemp, David Skinner, 52, Coverdale-road, Shepherd's Bush, W.
1882			‖Kemp, William Joel, F.I.C., Caerthillian, Sidcup, Kent
1903			Kemp-Welch, Maurice, B.A. (Cantab.), Parkstone, Weybridge, Surrey
1884			Kendall, George Frederic, B.A., The Hollies, Stratford-on-Avon
1874			Kendall, James Alfred, F.I.C., Lonesome Chemical Works, Streatham Common, S.W.
1896			‖Kennicott, Cass L., 314, Railway Exchange Building, Chicago, U.S.A.
1903			Kent, Thomas Oliver, 89, Loughboro'-park, Brixton, S.W.
1889			Kenwood, Henry Richard, M.B., C.M. (Edin.), L.R.C.P. (Lond.), Wadhurst, 150, Bethune-road, Stamford Hill, N.
1895			Kenyon, Richard Ernest, M.Sc. (Vict.), Shebbear College, Highampton, N. Devon
1903			Kerr, James Stewart, A.R.C.S., A.I.C., Methodist College, Belfast
1883			Kerry, William Hugh Rubens, The Sycamores, Windermere
1900			Kershaw, James Henry, Sewage Works, Aldwarke, Rotherham, York.
1901			Kettle, James David, B.Sc. (Lond.), 1, Vardens-road, St. John's Hill, Battersea, S.W.
1902			Kewley, James, B.A. (Cantab.), King William's College, Castletown, Isle of Man
1895			Kibble, William Oakes, F.I.C., General Post Office, Denver, Colorado, U.S.A.
1901			Kiddell, Christopher George, B.A., Hadley Highstone, Barnet, Herts.
1903			Kielty, John J., Nethersgate, Cairo-road, Walthamstow, Essex
1905			Killby, Leonard Gibbes, B.A. (Oxon.), 10, Aberdeen-park, Highbury, N.

Date of Election.			
1900			Kilner, George Washington, M.A. (Lond.), 4, Melrose-villas, Church End, Finchley, N.
1884			Kilpatrick, William Stirling, 6, Colebrook-street, Hillhead, Glasgow
1904			Kin, Thein, B.A. (Cal.), Chemical Examiner's Office, Rangoon, Lower Burma, India
1872	Trans.	C. 1887-92	‖Kinch, Edward, Prof., F.I.C., Royal Agricultural College, Cirencester
1881	Trans.		King, Alfred John, Rock Bank, Bollington, near Macclesfield
1902			‖King, Frank Eustace, B.Sc. (Lond.), A.I.C., Woodbury, Polworth-road, Streatham, S.W.
1903			King, Frank William George, 15, Almond-road, Tottenham, N.
1897			King, Herbert, M.Sc. (Vict.), F.I.C., 8, Avenue-road, Scarborough
1876			King, John Falconer, F.I.C., Laboratory of City Analyst, 20, Chambers-street, Edinburgh
1902			King, Sidney Isaac, 1, Russell-villas, Strawberry Hill, Middlesex
1895			Kingdon, George Holman, M.A. (Oxon.), c/o Messrs. Crosfield, Limited, Warrington, and Ivy Lodge, Froghall, Warrington
1872	Trans.		‖Kingzett, Charles Thomas, F.I.C., Elmstead Knoll, Chislehurst, Kent
1899			Kinnersley, Henry Wulff, A.I.C., London County Council, 40, Craven-street, W.C.
1895			‖Kinnicut, Leonard P., Prof., Sc.D. (Harv.), 77, Elm-street, Worcester, Mass., U.S.A.
1891	Trans.	C. 1894-6	‖Kipping, Frederic Stanley, Prof., D.Sc. (Lond.), Ph.D. (Munich), F.R.S., F.I.C., University College, Nottingham
1886			Kirby, Herbert E., St. Margaret's-mansions, Victoria-street, S.W.
1890			Kirk, Oliver, 7, Banklands, Workington
1895			‖Kirkaldy, Patrick Henry, F.I.C., Chemical Department, King's College, W.C.
1903			Kirkby, William, Winster House, Thornfield-road, Heaton Moor, Stockport
1889			Kitchin, John, The Middlesex Hospital, W.C.
1888			‖Knaggs, Alfred Battye, 37, Mannville-terrace, Bradford
1889			Knight, Frederick Charles, Boston and Colorado Smelting Company, Argo, Colorado, U.S.A.
1904			Knight, Harley Fancut, "Ledbury," 64, Amhurst-park, Stamford Hill, N.
1894			Knight, James, M.A., D.Sc. (Glas.), St. James's Public School, Calton, Glasgow
1896			Knight, John Burnett, Bushwood, Wanstead, Essex
1894			Knight, William Albert, Sexey's Trade School, Bruton, Somerset
1878			Knights, James West, F.I.C., County Laboratory, Cambridge

Date of Election			
1879			Knowles, Joshua, Stormer-hill, Tottington, Bury
1892			Knowles, Thomas Torrens, M.A. (Cantab.), 27, Peel-street, Princes Park, Liverpool
1864			Knox, G. W., B.Sc., 16, Finsbury-circus, E.C.
1873			Koch, Walter Edward, M.A., F.G.S., P.O. Box 718, El Paso, Texas, U.S.A.
1887	Trans.		Koga, Yoshimasa, The Imperial Mint, Osaka, Japan
1905			Komppa, Gustav, Prof., Ph.D., Polytechnik, Helsingfors, Finland
1885			Koningh, Leonard de, F.I.C., 4, St. Martin's-road, Stockwell, S.W.
1892			Krause, G., Prof., Cöthen (Anhalt), Germany
1859	Trans.		Kynaston, Josiah Wyckliffe, F.I.C., Chemical Laboratory, 3, Oak-terrace, Beech-street, Liverpool
1900			Kynaston, William Charles Robert, 9, Harland-road, Higher Tranmere, Birkenhead
1903			Laing, John, F.I.C., 5, Scone-gardens, Piershill, Edinburgh
1893			Lamb, Edmund George, M.A., Borden Wood, Liphook, Hants.
1900			Lamb, Morris Charles, Herold's Institute, Drummond-road, Bermondsey, S.E.
1892	Trans.		‖Lamb, Thornton Charles, Ph.D., c/o Messrs. Brunner, Mond and Co., Crescent Wharf, Silvertown, E.
1893			Lambert, Wesley J., 55, Plumstead Common-road, Plumstead, Kent
1904			Lamplough, Francis Edward Everard, B.A. (Cantab.), Trinity College, Cambridge
1877			Lancaster, William James, F.R.A.S., F.R.C.S., F.R.M.S., Pine Crest, Barnt Green, Worcs.
1902			Landau, A. Lionel, P.O. Box 4, Standerton, Transvaal, South Africa
1900	Trans.		Lander, George Druce, D.Sc. (Lond. and St. Andrews), F.I.C., Royal Veterinary College, Camden Town, N.W.
1886			Lang, William, Cross Park, Partick
1897	Trans.		Lang, William Robert, Prof., D.Sc. (Glasgow), F.I.C., The University, Toronto, Canada
1899			Lange, Ernest Frederick Stephen, Fairholm, Willow Bank, Fallowfield, Manchester
1885			Langer, Charles, Ph.D., Ynyspenllwch, Clydach, R.S.O., Glamorganshire
1891			‖Langham, Edgar Norman, Rev., M.A. (Cantab.), F.L.S., Head Master, Rastrick Grammar School, Brighouse
1894	Trans.	C. 1904–	Lapworth, Arthur, D.Sc. (Lond.), F.I.C., The Goldsmiths' Institute, New Cross, S.E.

Date of Election.		
1901	Proc.	Larter, Alfred Tabois, c/o The Dowson Economic Gas and Power Co., Ltd., Basingstoke Ironworks, Basingstoke, Hants.
1883		Lascelles, Brian Piers, M.A. (Oxon.), Longridge, High-street, Harrow-on-the-Hill
1880		Last, Frank Bernard, F.I.C., Western Mail-buildings, Cardiff
1901		Lattey, Robert Tabor, Trinity College, Oxford
1891	Trans.	Lauder, Alexander, D.Sc., Edinburgh and East of Scotland College of Agriculture, 13, George-square, Edinburgh
1904		Lauder, James Stanley, c/o B. Harvey, Esq., South Qu'Appelle, N.W.T., Assa., Canada
1886	Trans.	Laurie, Arthur Pillans, Principal, M.A. (Cantab.), D.Sc. (Edin.), F.R.S.E., The Heriot-Watt College, Edinburgh
1902		Lavelle, Selwyn Philip James, c/o Messrs. Mortimer and Co., Ltd., Driffield, East Yorks.
1876		‖Law, Channell, Ilsham Dene, Torquay
1896		‖Law, Herbert E., 2304, Van Ness-boulevard, San Francisco, Cal., U.S.A.
1890	Trans.	‖Law, Robert, F.I.C., The Royal Mint, Melbourne, Australia
1904		Lawrence, Henry William, c/o The Agricultural and Pastoral Food Co., Ltd., Davis-street, Wellington, New Zealand
1896	Trans.	Lawrence, William Trevor., B.A. (Oxon.), Ph.D. (Berlin), Burford, Dorking; and The University, Manchester
1900		Laws, Arthur Robert, 22, Belgrave-terrace, Newcastle-on-Tyne
1882		Laws, Joseph Parry, F.I.C., 2, Aigburth-vale, Liverpool
1890	Trans.	‖Laycock, William Frederick, Ph.D., 7, Park-street, Dewsbury
1890		Lea, Arthur Sheridan, M.A., Sc.D. (Cantab.), F.R.S., Sunnyside, Sidcup, Kent
1886		‖Leach, Walter, 21, St. Andrew's-place, Bradford
1904		Leadbetter, Harold Duff, 95, Capel-road, Forest Gate, E.
1902		Leader, George Herbert, Montego Bay Secondary School, Montego Bay, Jamaica
1894	Trans.	‖Lean, Bevan, B.A., D.Sc. (Lond.), Sidcot School, Winscombe, Somerset
1888		Lease, Frank Edward, Melapi Estate, Sandakan, British North Borneo
1902		Leather, John Petty, 17, Carlton-road, Burnley, Lancs.
1891	Trans.	Leather, John Walter, Ph.D. (Freiburg), F.I.C., Agricultural Research Institute, Pusa, Bengal, India
1900		‖Leathes, John Beresford, M.A., M.B., B.S. (Oxon.), 89, Albert Bridge-road, S.W.
1889		Ledingham, L. Napier, Govandale, Elmore-road, Sheffield
1883		Lee, Herbert C., The Conservative Club, St James'-street, S.W.
1898		Lee, Harry Lancelot, 32, Manor Drive, Headingley, Leeds

Date of Election.		
1883		Lee, Robert Brewer, B.A., B.Sc. (Lond.), 6, Warwick-street, Kensington, W.
1897	Trans.	Lee, Theophilus Henry, Laboratorio Chemico e Industrial de Alcides Medrado and Cia., Rua de Alfandega No. 71, Caixa do Correio No. 1172, Rio de Janeiro, Brazil
1905		Leech, Herbert Louis, 19, Hartington-street, Moss Side, Manchester
1891		Leeds, Frank Henley, F.I.C., 26, East Bank, Stamford Hill, N.
1905		Leek, William Henry, B.A. (Lond.), Elm View, Leigh, Lancs.
1899		Leeming, William Thomas, M.Sc. (Vict.), Simon Langton School, Canterbury
1873		Lees, Charles, Devonshire House, Bridlington Quay, Yorks.
1903	Trans.	Lees, Frederic Herbert, 256, Park-road, Crouch End, N.
1891		Leffler, Rudolf, 75, Harcourt-road, Sheffield
1889		‖Legg, John Edmund, M.A. (Cantab.), F.I.C., near Melton Hill, Woodbridge, Suffolk
1901		Lehmann, Adolf Ludwig Ferdinand, B.Sc. (Toronto), Ph.D. (Leipzig), Bangalore, Mysore, India
1891	Proc.	Leicester, James, Ph.D. (Erlangen), F.I.C., 17, Staverton-road, Oxford
1903		Leigh, Arthur Graham, jun., Chorcliffe House, Chorley, Lancs.
1889		Leigh, Cecil, F.I.C., Birmingham Metal and Munitions Co., Ltd., Adderley Park Rolling Mills, Birmingham
1904		Le May, Percy Kent, 6, Lothair-villas, Hatfield, Herts.
1891		Lennox, Robert N., Morvah, Hartington-road, Chiswick, S.W.
1899		Leon, Arthur Alexander, 5, Bullingham-mansions, Pitt-street, Kensington, W.
1882		Lescher, Frank Harwood, 60, Bartholomew-close, E.C., and 31, Devonshire-place, W.
1904		Lessing, Rudolf, Ph.D., c/o Gas Light and Coke Co., Tar Works, Beckton, E.
1902		Lessner, Charles B., Carril, Spain
1895	Trans.	‖Le Sueur, Henry Rondel, D.Sc. (Lond.), F.I.C., St. Thomas's Hospital, S.E.
1896	Trans.	Lethbridge, William Arthur Finch, B.A. (Oxon.), 20, Victoria-road, Clapham Common, S.W.
1899		Lett, Stephen Joshua, Hall o' th' gate, Crosby Ravensworth, Shap, S.O. Westmoreland
1879		Letts, Edmund Albert, Prof., Hon. D.Sc. (R.U.I.), Ph.D. (Göttingen), F.I.C., Queen's College, Belfast
1905		Levy, Arthur Garfield, B.Sc. (Lond.), A.I.C , c/o B. Blount, Esq., 76, York-street, Westminster, S.W.
1903		Levy, Henry Wolff, 423B, Little Collins-street, Melbourne, Australia

Date of Election.			
1888	Trans.		Lewes, Vivian Byam, Prof., F.I.C., 19, Park-row, Greenwich, S.E.
1899	Trans.		Lewis, Edward Watkin, Hollycroft, Loughton, Essex
1901			Lewis, Ernest Alfred, 310, Dudley-road, Birmingham
1905			Lewis, Ernest Isaac, B.A. (Cantab.), B.Sc. (Lond.), Oundle School, Oundle
1903			Lewis, Harry Percy, 9, Calvert-terrace, Swansea
1894	Trans.		Lewis, William Henry, M.A. (Oxon.), F.I.C., 24, Wonford-road, Exeter
1869	Trans.		‖Lewis, W. J., Prof., New Museums, Cambridge
1888	Trans.	C. 1902–03	Lewkowitsch, Julius, Ph.D. (Breslau), F.I.C., 71, Priory-road, West Hampstead, N.W.
1878			‖Lichtenstein, Theodore David, F.I.C., Chemical Works, Silvertown, E.
1896			Lidgey, Cecil Rudolf, 50a, Forest-hill-road, East Dulwich, S.E.
1900			Liebmann, Adolf, M.A., Ph.D. (Bonn.), 16, Darley-avenue, West Didsbury, Manchester
1903			Linday, John Howard, Y.M.C.A., Totterdown, Bristol
1901			Linde, Harold Theodor Granville van der, 101, Tyndall-avenue, Toronto, Canada
1892			Lindley, Hubert Edward, Rose Villa, Pinner-road, Harrow
1899			Lindsey, Robert William, 22, Hilldrop-crescent, Camden-road, N.
1886	Trans.		Ling, Arthur Robert, F.I.C., Hazeldene, Kingston-road, New Malden, Surrey
1899			Linstead, Edward Flatman, 15, Station-avenue, Winchmore Hill, N.
1902			Liotard, Ernest, 2, Rue de France, Nice, France
1905			Lister, Joseph, B.Sc. Lond.), A.R.C.S., 50, Portland-street, Lancaster
1853	Trans.	V.P. 1883-7 1898-1901	‖Liveing, George Downing, Prof., M.A. (Cantab.), Hon. Sc.D. (Dublin), F.R.S., The Pightle, Cambridge
1872	Trans.		‖Liversidge, Archibald, Prof. M.A. (Cantab.), Hon. LL.D. (Glas.), A.R.S.M., F.R.S., F.I.C., The University, Sydney, and The Octagon, St. Mark's-road, Darling Point, Sydney, N.S.W.
1903			Livesey, Charles Edwin Leonard, B.Sc. (Vict.), Stonyhurst College, Blackburn, Lancs.
1883			Livingston, William John, F.I.C., London County Council, Spring-gardens, S.W.
1880			‖Lloyd, Alfred, The Dome, Bognor, Sussex
1876	Trans.		Lloyd, Frederick James, F.I.C., Muscovy House, 6, Trinity-square, E.C.
1905			Lloyd, George Moss, M.A. (Vict.), M.Sc. (Liverpool), "Homeland," Queen's-road, Rock Ferry, Cheshire.

Date of Election.		
1893		Lloyd, Herbert, Allegheny-avenue, and 19th-street, Philadelphia, U.S.A.
1896		Lloyd, Thomas Henry, c/o Messrs. Quibell Bros., Ltd., Newark-on-Trent
1900		Lockhart, Thomas Lamb, P.O. Box 231, Glencairn Main Reef Gold Mining Co., Ltd., Germiston, Transvaal, South Africa
1902		Lockitt, Charles Henry, B.A. (Lond.), 5, Harley-road, South Hampstead, N.W.
1896		Lockwood, Thomas William, Heckmondwike, Yorks.
1871		Lockyer, William John, 7, St. Julian's Farm-road, West Norwood, S.E.
1903		Logan, Thomas Stratford, The Colony, Ewell, Surrey
1884		London, John Edward, M.D. (Dun.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), 62, Main-street, Georgetown, Demerara, West Indies
1872		||Longstaff, George Blundell, M.A., M.D. (Oxon.), F.R.C.P., M.R.C.S., Highlands, Putney Heath, S.W.
1905		Longstaff, James Patrick, B.Sc. (Edin.), 19, Fettes-row, Edinburgh
1873		||Loram, Herbert Yabsley, F.I.C., 49, Buxton-road, Chingford, Essex
1878	Trans.	||Louis, David Alexander, F.I.C., 77, Shirland-gardens, Maida Vale, W.
1882		Love, Edward G., Ph.D., 80, East 55th-street, New York, U.S.A.
1882		||Lovibond, Thomas Watson, F.I.C., Hesleyside, Bellingham, R.S.O., Northumberland
1884		||Low, Charles William, M.B. (Dun.), L.R.C.S. (Eng.), L.R.C.P. (Lond.), Stricklands, Stowmarket, Suffolk
1904	Trans.	Lowe, Frank Harold, B.Sc. (Vict.), South-Western Polytechnic, Manresa road, Chelsea, S.W.
1878		||Lowe, Walter Bezant, M.A. (Cantab.), Cae Carw, Llanfairfechan, North Wales
1876		Lowe, William Foulkes, A.R.S.M., F.I.C., 9, Hough-green, Chester
1898	Trans.	||Lowry, Thomas Martin, D.Sc. (Lond.), 130, Horseferry-road, Westminster, S.W.
1901		Lowson, William, B.Sc. (Lond.), F.I.C., The University, Leeds
1899		Lucas, Alfred, Survey Department, Public Works Ministry, Cairo, Egypt
1905		Lucas, Edward William, F.I.C., 2, Hills-place, Oxford-street, W.
1902		Lucas, Harry, 1, St. Agnes'-place, Kennington Park, S.E.
1902	Trans.	Ludlam, Ernest Bowman, Ackworth School, Ackworth, near Pontefract, Yorks.
1891		Ludlow, Lionel, Standard Bank of South Africa, Bulawayo, Rhodesia, South Africa, and Southville, Swansea

Date of Election.		
1877	Trans.	‖Luff, Arthur Pearson, M.D., B.Sc. (Lond.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., 9, Queen Anne-street, Cavendish-square, W.
1890	Trans.	Lumsden, John S., D.Sc., Ph.D. (Munich), 9, Rosewood-terrace, West Park, Dundee
1867	Trans.	‖Lunge, Georg, Prof., Ph.D., Steinwiesstrasse, 40, Zürich, Switzerland
1872	Trans.	‖Lupton, Sydney, 102, Park-street, Grosvenor-square, W.
1893	Trans.	Luxmoore, Charles Mann, D.Sc. (Lond.), F.I.C., University College, and Lozoth, Caversham Heights, Reading
1899		Luxton, Thomas, B.A., B.Sc. (Lond.), 28, Albany-street, Hull
1873		Lyon, Isidore Bernadotte, Brigade Surgeon, Lieut.-Col., C.I.E., F.I.C., East India U.S. Club, 16, St. James's-square, S.W., and 164, Sutherland-avenue, W.
1874		Lyon, John George, F.I.C., The Aire Tar Works, Knottingley, Yorks.
1886	Trans.	Lyons, Albert Brown, A.M., M.D., 72, Brainard-street, Detroit, Mich., U.S.A.
1859		‖Lyte, Farnham Maxwell, M.A. (Cantab.), F.I.C., A.I.C.E., 17, Mentone-mansions, Fulham-road, S.W.
1888		Maben, Thomas, Kenmure, 63, Stradella-road, Herne Hill, S.E.
1896		Macadam, Herbert Edwin, Odam's Wharf, Victoria Docks, E.
1888		‖Macadam, Stevenson John Charles George, F.I.C., Analytical Laboratory, 55, York-place, Edinburgh
1899		McAlley, James, West-drive, Irvine, N.B.
1900		Macara, Thomas, F.I.C., 6, Sutherland-terrace, Dowanhill, Glasgow
1890		‖MacArthur, John Stewart, 74, York-street, Glasgow
1887		‖McArthur, John, F.R.S.E., 196, Trinity-road, Wandsworth Common, S.W.
1888		McBretney, Edmund George, F.I.C., 23, Ferrybridge-road, Castleford, Yorks.
1900		McCall, William, 8, Beaton-road, Maxwell-park, Glasgow
1902		MacCallum, Douglas Archibald, Central-chambers, 93, Hope-street, Glasgow
1899		McClumpha, Robert, 372, Westgate-road, Newcastle-on-Tyne
1890	Trans.	McConnell, Arthur Hotham, 33, Digby-mansions, Bridge-road, Hammersmith, W.
1904		McCourt, Cyril Douglas, A.C.G.I., 52, Victoria-road, Clapham, S.W.
1875		‖McCowan, William, F.I.C., Essex Wharf, Narrow-street, Limehouse, E.

Date of Election.		
1899		McCracken, James, 3, Rosemount-terrace, Ibrox, Glasgow
1896	Trans.	McCrae, John, jun., Ph.D., 7, Kirklee-gardens, Kelvinside, Glasgow
1899		McCreath, W. D., Quantock Vale Cider Co., Ltd., North Petherton, Bridgwater
1890		‖McCubbin, William Alexander, F.I.C., 35, The Temple, Dale-street, Liverpool
1897		MacCulloch, Charles, Auckland Club, Auckland, New Zealand
1894		McCutcheon, James, 21, Braidburn-crescent, Edinburgh
1903		Macdonald, David Baird, 18, Kimberley-road, Leicester
1901		Macdonald, F. G., Cyanide Manager, Durban Roodeport Gold Mining Co., Ltd., P.O. Box 111, Roodeport, Transvaal, South Africa
1894	Trans.	MacDonald, George William, M.Sc. (Melbourne), c/o Messrs. Curtis and Harvey, Ltd., Dartford, Kent
1901		Macdonald, Peter E., c/o The Mazapil Copper Co., Ltd., Concepcion del Oro, Zacatecas, Mexico
1891		MacDonald, William G., c/o Dr. C. C. Stuhlmann, Tung Wen Kwan, Peking
1904		McDougall, Arthur Thomas, B.A. (Lond.), 3, Albion-road, College Park, S.E.
1874		McDougall, John, Clifton House, Greenwich Park, S.E.
1886		MacEwan, Peter, 64, Southwood-lane, Highgate, N.
1898		McEwen, Antholl Francis, P.O. Box 6055, Johannesburg, South Africa
1895		MacFarlane, Alexander, Loch Sloy, 5, North-road, Glossop
1891		Macfie, Robert Andrew Scott, M.A. (Cantab.), B.Sc. (Edin.), 34, Moorfields, Liverpool
1895		McGlashan, John, Cawnpore Sugar Works, Cawnpore, India
1887	Trans.	McGowan, George, Ph.D. (Leipzig), F.I.C., 21, Montpelier-road, Ealing, W.
1893		McGregory, Joseph Frank, Prof., Colgate University, Hamilton, New York, U.S.A.
1890		Macintyre, Alfred E., The Chemical Laboratory, Dominion Arsenal, Quebec, Canada
1877		‖Mackay, Angus, 450, Darling-street, Balmain, Sydney, N.S.W.
1890		Mackean, William, c/o Welsbach Incandescent Gas Light Co., Ltd., Broomhill-road, Wandsworth, S.W.
1901	Trans.	McKenzie, Alexander, M.A., D.Sc. (St. Andrews), Ph.D. (Berlin), Chemical Department, The University, Birmingham
1897	Trans.	Mackenzie, John Edwin, D.Sc. (Edin.), Ph.D. (Strassburg), Birkbeck University College, Bream's Buildings, E.C.
1902		Mackenzie, John Ross, The Worcester Brewery, Worcester
1899		Mackenzie, Thomas, 4, Church-street, Inverness

Date of Election			
1900			Mackenzie, Thomas Ebenezer, The Capillitas Copper Co., Ltd., Pilciao, Provincia de Catamarca, Argentine Republic, S. America
1892			Mackenzie, William Cossar, D.Sc. (Edin.), Tewfikieh College of Agriculture, Gheezeh, Cairo
1893			McKerrow, Charles Alexander, 8, Exchange-street, Manchester
1892			McKerrow, William James, D.Sc. (Tübingen), F.I.C., c/o Messrs. Field and Co., Upper Marsh, Lambeth, S.W.
1902	Trans.		Macknight, Alexander, 67, Oak-road, Crumpsall, Manchester
1897			Maclaurin, James Scott, D.Sc. (N.Z.), Wellington, New Zealand
1868	Trans.	C. 1871-4 80-4,87-90 95-9. V.P. 1887-90, 1901-04	‖McLeod, Herbert, Prof., F.R.S., F.I.C., 9, Coverdale, Montague-road, Richmond, Surrey
1899			MacLeod, James, F.I.C., West Hill, Cardross-road, Dumbarton
1904			MacMahon, Frederick William, 31, Marler-road, Forest-hill, S.E.
1879			‖Macmillan, J. Laker, 11, Bond-street, Sydney, N.S.W.
1897			Macmullen, Alan, B.A. (Oxon.), The Manor House, Raheny, R.S.O., Co. Dublin
1881			MacMunn, Charles Alexander, M.A. (Dub.), M.D. (Dub.), L.R.C.S. (Ireland), F.R.M.S., Oakleigh, Wolverhampton
1889	Trans.		‖McMurtry, George Cannon, Wallaroo Smelting Works, Wallaroo, South Australia.
1880			Macnab, William, F.I.C., 10, Cromwell-crescent, S.W.
1885	Trans.		‖Macnair, Duncan Scott, Ph.D., B.Sc., 67, Braid-avenue, Edinburgh
1900			McNair, Hugh, Bellfield, Wishaw, N.B.
1905			Maguire, Peter, Hamer House, Rochdale, Lancs.
1899			Main, Hugh, B.Sc. (Lond.), "Almondale," Buckingham-road, South Woodford, N.E.
1900			Mair, William, 7, Comiston-road, Edinburgh
1902	Trans.		Maitland, William, B.Sc., Auchmill, Bucksburn, Aberdeenshire, N.B.
1892			Major, George Harry, Devonshire-street, Ardwick, Manchester
1894			Makin, Charles James Shaw, F.I.C., Thorn Bank, Leamington
1885	Trans.		‖Mallet, Frederic Richard, F.I.C., 20, King's avenue, Ealing, W.
1857	Trans.	V.P. 1888-91	Mallet, John William, Prof., Ph.D. (Göttingen), M.D., LL.D., F.R.S., University of Virginia, Albemarle Co., Va., U.S.A.
1897			Mallinson, Willie Lee, Gawthorp-green, Kirkheaton, near Huddersfield
1904			Mander, Alfred, Berkswell, Malvern
1903			Mander, Percy George, B.Sc. (Lond.), The School House, Ashby-de-la-Zouch
1903			Mann, Ernest William, "Lyndale," Northfield-road, King's Norton, Birmingham

Date of Election			
1903			Mann, John Christopher, 9, Lambert-street, Hull
1903			Mann, William, B.Sc. (Lond.), 59, Blackheath-road, Greenwich, S.E.
1896			Manners, Hugh, M.A., B.Sc. (Glas.), Academy House, Airdrie, N.B.
1897			Mansford, Charles John Jodrell, B.A. (Lond.), The Grammar School, Dartford, Kent
1895			‖Marchant, Robert Charles, 18, Elliston-road, Redland, Bristol
1896			Marks, Edward Seaborn, c/o David Marks, Esq., 23, Palace Gate, S.W.
1905			Marle, Ernest Robert, B.Sc. (Lond.), A.R.C.S., 135, Le Marchant-road, St. John's, Newfoundland
1895			Marsden, Prosper Henry, The Royal Infirmary, Liverpool
1881			‖Marsh, Charles W., Ph.D.
1903			Marsh, John, 29, High-street, Maidstone
1883	Trans.	C. 1902-	‖Marsh, James Ernest, M.A. (Oxon.), University Museum, Oxford
1895	Proc.		Marshall, Arthur, F.I.C., Hope Cottage, Church-hill, Loughton
1890	Trans.		Marshall, Hugh, D.Sc. (Edin.), F.R.S., F.R.S.E., 12, Lonsdale-terrace, Edinburgh
1896			Marshall, Percy Sykes, Union Laboratory, Half Moon-street, Huddersfield
1891			Marshall, Reginald Tom, 57, Maplethorp-road, Thornton Heath, S.E.
1887			Marshall, William, F.I.C., Carisbrook, Queen's-road, Cheadle Hulme, Cheshire
1897			Martin, Charles Henry, 40, Bolton-road, Pendleton, Salford
1902			Martin, Francis, 3, York-terrace, Eglinton-road, Plumstead, S.E.
1904			Martin, Francis Grimshaw, 1, Harbury-road, Birmingham
1898	Trans.		‖Martin, George Herbert, M.A. (Oxon.), 8, Selborne-terrace, Bradford, Yorks.
1885			‖Martin, Gerald Ward, Lieut.-Col., F.R.G.S., 8, Petersham-terrace, Gloucester-road, S.W.
1901			Martin, Nicholas Henry, Ravenswood, Low Fell, Gateshead-on-Tyne
1883			Martin, William Henry, 183, King's-road, Chelsea, S.W.
1902			Martindale, William Harrison, 10, New Cavendish-street, W.
1871			‖Martineau, George, 21, Mincing-lane, E.C., and Gomshall Lodge, Gomshall, Surrey
1887			‖Martineau, Sydney, Northwood, Rydal-road, Streatham, S.W.
1898			Mascarenhas, John Charles, Lisbon House, 54, Percy-road, Upton Park, E.
1851	Trans	(C. 1858-9, 75-7. V.P. 78-81)	Maskelyne, Nevil Story, M.A., Hon. D.Sc. (Oxon.), F.R.S., Salthrop, Wroughton, Wilts.
1905			Mason, Arthur Walter, B.Sc. (Lond.), 6, Northumberland-place, North Shields

Date of Election.			
1890			Mason, Francis Herbert, Queen-buildings, Hollis-street, Halifax, Nova Scotia
1889			Mason, James Braik, The West End Laboratory, Dundee
1882	Trans.		Masson, David Orme, Prof., M.A., D.Sc. (Edin.), F.R.S., The University of Melbourne, Victoria, Australia
1897			Masters, Edward, 53, Dulverton-road, Leicester
1873			‖Masters, William, St. Erme, Moorend Park-road, Cheltenham
1904			Mathews, Harold Joseph Clarke, Massey's Burnley Brewery, Ltd., Burnley, Lancs.
1896			Mathieson, Lawrence W., 1, Rosebery-road, New Brompton, R.S.O., Kent
1902			Mathieson, Robert, J.P., Rill Bank, Innerleithen, Peeblesshire
1876	Trans.		‖Matthews, Charles George, F.I.C., Abendberg, 31, Stapenhill-road, Burton-on-Trent
1880	Trans.		‖Matthews, Francis Edward, Ph.D. (Göttingen), F.I.C., Cooper's Hill, Englefield Green, Surrey
1884			‖Matthey, Edward, Col., C.B., 31a, Weymouth-street, W.
1870		C. 1877-9	Matthey, George, A.I.C.E., F.R.S., 78, Hatton-garden, E.C.
1905			Maughan, Reginald Bruce, P.O. Box, 46, Bundaberg, Queensland
1893			‖Mawer, William Frederick, 332, Kennington-road, S.E.
1865			‖Maxwell, Theodore, B.A., M.D. (Cantab.), F.R.C.S. (Edin.), B.Sc. (Lond.), 29, Woolwich Common, S.E.
1896			Mayfield, Arthur Stanley, 14, Beresford-avenue, Newland, Hull
1892			Meacham, Charles Stephen, c/o Messrs. Ohlsson's Cape Breweries, Ltd., Newlands, Cape Town, South Africa
1898			Meads, Charles James, Bel Air, Dartmouth, Devon
1904			Mears, Francis D'Oyley, jun., 4, Nyanza-terrace, Swansea
1901	Trans.		Mees, Charles Edward Kenneth, B.Sc. (Lond.), Ryelands Caterham, Surrey
1896			Meggitt, Loxley, F.I.C., c/o C.W.S., Ltd., Wheatsheaf Works, Alexandriva, Sydney, N.S.W.
1871	Trans.	C. 1883-7, 90-91 F.S. 1891-1902 V.P. 1902-05 P. 1905-	‖Meldola, Raphael, Prof., F.R.S., F.I.C., Finsbury Technical College, Leonard-street, E.C., and 6, Brunswick-square, W.C.
1905	Trans.		Meldrum, Andrew Norman, D.Sc. (Aberd.), 16, Mooroaks-road, Sheffield
1895			Meldrum, Robert, Glynwood, 37, Foyle-road, Blackheath, S.E.
1894			Melland, Godfrey, M.Sc. (Vict.), A.R.S.M., F.I.C., Chemical Department, The Polytechnic, Woolwich, S.E.
1902	Trans.		Mellor, Joseph William, D.Sc. (N.Z.), West View, near Longport Station, Wolstanton, Staffs.
1875			Melmore, Pattinson B., Chemical Laboratory, Maryport

Date of Election.			
1902			Mence, George Augustus Henry, B.Sc., Borden School, Sittingbourne, Kent
1900	Proc.		Menzies, Alan W. Cranbrook, Prof., M.A., B.Sc., St. Mungo's College, Castle-street, Glasgow
1901			Menzies, James, 39, Winterbrook-road, Herne Hill, S.E.
1889			Mercer, Thomas, F.I.C., The Lion Brewery, Eastbourne
1901			Meredith, William, 63, Albion-place, Ulverston, Lancs.
1896			Merrett, William Henry, A.R.S.M., F.I.C., Hatherley, Grosvenor-road, Wallington, Surrey
1891			Merrils, Frederick Johnson, 13, Rutland-park, Sheffield
1897			Merson, George Fowlie, 7, King-street, Kilmarnock, N.B.
1876	Trans.	{C. 1884-8, 1897-1901}	‖Messel, Rudolph, Ph.D., 147, Victoria-street, Westminster, S.W.
1900			Meyer, Hans, Ph.D., 1, Salmgasse, Prague, Bohemia
1904			Middleditch, Bernard, B.A. (Cantab.), Woodcroft, Harrow-on-the-Hill
1888	Trans.	{V.P. 1901-04}	‖Miers, Henry Alexander, Prof., M.A., D.Sc. (Oxon.), F.R.S., F.G.S., Magdalen College, Oxford
1904			Millar, Ernest Westby, Windsor, Monkstown, Co. Dublin.
1843			‖Millar, James.
1892	Trans.		Millar, James Hill, F.I.C., The Laboratory, St. James' Gate Brewery, Dublin
1891			‖Millard, Edgar J., F.R.M.S., 35–42, Charlotte-street, Great Eastern-street, E.C.
1880	Trans.		‖Miller, Alexander Kenneth, Ph.D. (Würzburg), F.I.C., Kilvert's-buildings, Withy Grove, Manchester
1897			Miller, Edmund Howd, M.A., Ph.D. (Columbia), Columbia University, New York City, U.S.A.
1902			Miller, Edward Holl, Common Hall, Hadleigh, Essex
1889			Miller, Harry East, Ph.D. (Strassburg), 1015, Chestnut-street, Oakland, California, U.S.A.
1889	Trans.		Miller, James Bruce, A.I.C., Rubislaw Den North, Aberdeen
1887			Miller, John A., M.Sc., Ph.D. (Berlin), 44 & 45, Lewis Block, Buffalo, New York, U.S.A.
1885	Trans.		‖Miller, Norman Harry John, Ph.D. (Würzburg), F.I.C., Harpenden, Herts.
1898			Miller, William Lash, B.A., Ph.D., 50, St. Alban-street, Toronto, Canada
1896			Miller, William M., Caledonia Estate, Wellesley Province, Penang, Straits Settlements
1903	Proc.		Millington, John Price, B.A. (Cantab.), B.Sc. (Wales), Royal Societies' Club, St. James's-street, S.W.
1893	Trans.		‖Mills, Charles, F.I.C., P.O. Box 112, Kroonstad, South Africa

Date of Election.			
1862	Trans.	C. 1868-72, 75-6, 80-4, 1903-	‖Mills, Edmund James, Prof., D.Sc. (Lond.), LL.D. (Glas.), F.R.S., F.I.C., 64, Twyford-avenue, West Acton, W.
1898	Trans.		Mills, William Hobson, M.A. (Cantab.), Sc.D. (Tübingen), The Northern Polytechnic Institute, Holloway, N.
1905	Trans.		Mills, William Sloan, M.A., Queen's College, Galway
1885			‖Milne, Alexander, Lieut.-Col. I.M.S., M.A., M.B., M.Ch. (Aberd.), H.M.'s Mint, Bombay, India.
1887			Mingaye, John Charles Henderson, F.I.C., Department of Mines, Assay Branch, Sydney, N.S.W.
1898			‖Mitchell, Albert Henry, B.Sc. (Lond.), F.I.C., Borough Analyst's Laboratory, 10, Morley-terrace, Tiverton, Devon
1897			Mitchell, Tom, Cemetery House, Shaw, near Oldham
1899			Mohr, Bernard, Ph.D. (Heidelberg), 69A, Parliament Hill, Hampstead, N.W.
1901	Trans.		Moir, James, M.A., D.Sc., Chemical Laboratory, Mines Department, Winchester House, Johannesburg, Transvaal, South Africa.
1893			Mole, Herbert Bloome, The Croft, Shepton Mallet
1902			Molesworth, Francis Hylton, Jersey-road, Artarmon, Sydney, N.S.W.
1899			Molson, John Cavendish, M.D., L.R.C.P. (Lond.), F.R.G.S., 1, Pavilion-buildings, Brighton
1899			Mond, Emile Schweich, 22, Hyde-park-square, W.
1872	Trans.	C. 1885-6 V.P. 87-90, 94-8	‖Mond, Ludwig, Hon. D.Sc. (Vict.), Hon. Ph.D. (Heidelberg), F.R.S., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1892			Mond, Robert Ludwig, M.A. (Cantab.), F.R.S.E., The Poplars, 20, Avenue-road, Regent's Park, N.W.
1879			‖Mondy, Edmund Felix, "Dacca," 96, Huron-road, Balham, S.W.
1903			Monier-Williams, Gordon Wickham, The Lammas, Esher, Surrey
1904			Montgomery, Jack Percival, Ph.D. (Va.), A.M. (Clarksville), Agricultural College, Starkville, Miss., U.S.A.
1887	Trans.	C. 1899-1900, 1905-	‖Moody, Gerald Tattersall, D.Sc. (Lond.), F.I.C., Lorne House, North Dulwich, S.E.
1902			Moody, James Butler, Bridge Cottage, Wakefield
1897			Moon, Philip George Gregory, The Laboratory, British Gas Light Co., Ltd., Norwich
1892			‖Moor, Cresacre George, M.A. (Cantab.), F.I.C., 4, Dane's Inn, Strand, W.C.
1903			Moore, Alfred Ernest, B.A., B.Sc. (Lond.), Escuela Normal Regional, Corrientes, Argentine Republic
1903			Moore, Arthur, 109, Elgin-road, Seven Kings, Essex
1905	Trans.		Moore, Charles Watson, B.Sc. (Vict.), 38, Demesne-road, Whalley Range, Manchester.

Date of Election.			
1891			Moore, Frederick Herbert, 39, Lime-street, E.C.
1902			Moore, Thomas Henry, c/o Messrs. Burroughs, Wellcome & Co., Ltd., Box 1013, Cape Town, South Africa
1904	Trans.		Moore, Tom Sidney, B.A. (Oxon.), B.Sc. (Lond.), The University, Birmingham
1895			Morgan, David James, M.A., M.B., B.S. (Cantab.), Holkham, St. James'-road, Sutton, Surrey
1897			Morgan, Frederick Filmer de, 4, Orchard-house, County Grove, Camberwell, S.E.
1898	Trans.		‖Morgan, Gilbert Thomas, D.Sc. (Lond.), A.R.C.S., F.I.C., Royal College of Science, South Kensington, S.W., and 15, Fawcett-street, Redcliffe-gardens, S.W.
1888			‖Morgan, John James, F.I.C., The Laboratory, Messrs. Cammell, Laird and Co , Ltd., Workington, Cumberland
1900			Morgan, John Livingston Rutgers, A.M., Ph.D. (Leipzig), B.Sc., Adjunct Professor of Physical Chemistry, Columbia University, N.Y., U.S.A.
1880	Trans.		Moritz, Edward Ralph, Ph.D. (Göttingen), F.I.C., 45, Great Tower-street, E.C.
1879	Trans.	C. 87-90 96-1900	‖Morley, Henry Forster, M.A., D.Sc. (Lond.), F.I.C., 5, Lyndhurst-road, South Hampstead, N.W.
1895	Trans.		‖Morrell, Robert Selby, M.A. (Cantab.), Ph.D. (Würzburg), Gonville and Caius College, Cambridge
1892			Morris, Albert, B.A., B.Sc. (Lond.), Fern Bank, Dukinfield
1900			Morris, Edgar Ford, M.A. (Oxon.), Grey House, Barrington-road, Altrincham, Cheshire
1905			Morris, Edwin, A.R.C.S., A.R.S.M., 12, Dragon-view, Harrogate
1891			Morris, Joseph, Ph.D., Fern Bank, 8, Boardman-street, Eccles, Manchester
1851			Morson, Thomas, c/o Messrs. T. Morson and Son, Chemical Works, Ponders End, N.
1905			Mortimer, Alfred, B.A. (Oxon.), Trinity College, Stratford-on-Avon
1872			Morton, Edward Handfield, 88, Wigmore-street, W.
1893			Morton, Frederick, Chemical Works, Milnsbridge, Huddersfield
1890	Trans.		Mosenthal, Henry de, F.I.C., 220, Winchester-house, Old Broad-street, E.C.
1896			Moss, Francis Ambrose, Kalgurli Gold Mines, Ltd, Kalgoorlie, Western Australia
1871			‖Moss, Richard Jackson, F.I.C., St. Aubyns, Ballybrack, Co. Dublin
1898			Moss, William Edward, 2, Windermere-terrace, Princes-park, Liverpool
1886			Moul, Frank, F.I.C., Aldersgate Chemical Works, Southall

Date of Election.			
1884			‖Moyle, Robert Edward, M.A. (Oxon.), Heightley, Chudleigh, South Devon
1902			Müller, Christian, 9, Baronsfield-road, East Twickenham, Middlesex
1859	Trans.	C. 1863-6 F.S. 69-85 P. 85-7	‖Müller, Hugo, Ph.D., LL.D. (St. Andrews), F.R.S., 13, Park-square East, Regent's Park, N.W.
1896			Muir, James Stanley, B.Sc. (Glas.), 8, Westminster-gardens, Hillhead, Glasgow
1871	Trans.	C. 1890-4	Muir, Matthew Moncrieff Pattison, M.A. (Cantab.), Gonville and Caius College, Cambridge
1870			‖Muirhead, Alexander, D.Sc. (Lond.), F.R.S., The Lodge, Shortlands, Kent
1903			Mukerjee, Beni Madhav, B.A. (Allahabad), Thomason College, Roorkee, India
1893	Proc.		Munby, Alan Edward, M.A. (Cantab.), 7, Chalcot-crescent, Primrose Hill, N.W.
1902			Mundey, Alfred Holley, 14, Wrottesley-road, Plumstead, Kent
1876	Trans.		Munro, John May Herbert, D.Sc. (Lond.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), F.I.C., 5, Duke-street, Bath
1888			Munroe, Charles E., Prof., Columbian University, Washington, D.C., U.S.A.
1900			Munton, Frederick Thomas, Beaconsfield, Western-road, Runcorn, Cheshire
1901			Murphy, Albert John, 11, Lyddon-terrace, Leeds
1904			Murray, Benjamin L., B.S. (Mich.), 19, University-place, New York, U.S.A.
1893			Murray, John Alan, B.Sc. (Edin.), 5, Caergog-terrace, and University College of Wales, Aberystwyth
1894			Murray, John Moore, M.Sc. (Vict.), 11, Winmarleigh-street, Warrington
1890	Trans.		‖Murray, Thomas Smith, D.Sc. (Edin.), 1, Nelson-street, Dundee
1869			‖Muspratt, Edmund Knowles, F.I.C., Seaforth Hall, near Liverpool
1873			‖Muspratt, Sidney Knowles, 9, Church-street, Flint, North Wales
1896			Muter, Alexander Henry Mitchell, F.I.C., Laboratory, 325, Kennington-road, S.E.; and The Châtelet, Horley, Surrey
1870	Trans.		‖Muter, John, Ph.D. (Rostock), F.R.S.E., F.I.C., Laboratory, 325, Kennington-road, London, S.E.; and The Châtelet, Horley, Surrey
1892	Trans.		Myers, William Shields, M.Sc. (N.J.), Associate Prof. of Chemistry, Rutger's College, 15, Union-street, New Brunswick, N.J., U.S.A.

Date of Election.		
1887		Nagel, David Henry, M.A. (Oxon.), Trinity College, Oxford
1903		Nairne, Urban Orlando Scotchburn, 7, Hawthorne-terrace, Ripple-road, Barking, Essex
1899	Proc.	Nance, John Trengove, M.A. (Oxon.), Elmshurst, Bromsgrove, Worcs.
1874		‖Napier, Arthur S., Prof., B.Sc., c/o Herren Mayer and Müller, 2, Prinz Louis Ferdinandstrasse, Berlin
1893		Napier, John Watson, Corporation Gas Works, Alloa, N.B.
1900	Proc.	Napper, Sidney Scrivener, A.C.G.I., A.I.C., c/o Messrs. S. Cortauld & Co., Ltd., Foleshill-road, Coventry
1898		Nash, Leonard Myddelton, F.I.C., 281, Seven Sisters-road, Finsbury Park, N.
1900		Naylor, Ernest Brooks, M.Sc. (Vict.), 73, Castle-street, Bolton
1891		Naylor, William, 3, Garstang-road, Fulwood-park, Preston
1878	Trans.	Naylor, William Arthur Harrison, F.I.C., 38, Southwark-street, S.E.
1899	Trans.	Neale, Harry Ainley, Vernon, British Columbia
1898		Neilson, Alexander MacGillivray, c/o Messrs. Arthur May & Co., Durban, Natal, South Africa
1901		Neumann, Edgar David Maurice, M.A. (Oxon.), Ph.D. (Göttingen), A.I.C., 7 & 8, Idol-lane, E.C.
1878	Trans.	‖Nevile, R. H. C., Wellingore Hall, Lincoln
1871	Trans.	‖Nevill, Edmund Neville, F.I.C., Government Laboratory, Durban, Natal
1890	Trans.	Neville, Francis Henry, M.A. (Cantab.), F.R.S., Sidney College, Cambridge
1892		‖Newall, John Fenton, 33, George-street, Manchester
1885		‖Newbolt, Francis George, Balliol College Laboratory, Oxford
1901		Newbould, Herbert Simpson, 2, Clyde-road, West Didsbury, Manchester
1864		‖Newlands, Benjamin Edward Reina, F.I.C., 2, St. Dunstan's-hill, E.C.
1891		‖Newlands, William P. R., 10, Cricklade-avenue, Streatham Hill, S.W.
1889		Newsholme, George Thomas Wilkinson, 27, High-street, Sheffield
1894	Trans.	Newth, George S., F.I.C., Royal College of Science, South Kensington, S.W.
1895		Newton, Charles Butterworth, Whitehall-chambers, Carlisle
1883		Newton, William, Ph.D. (Zürich), F.I.C., 39, Mincing-lane, E.C.
1899	Proc.	Nicholls, William Walter Scott, B.Sc., 230, Brockley-road, Brockley, S.E.
1870	Trans.	‖Nicholson, Edward, Brigade Surgeon, Lieut.-Col., M.R.C.S. (Eng.), L.S.A. (Lond.), D.P.H. (Cantab.), F.I.C., 1, Huskisson-street, Liverpool

Date of Election.			
1889			Nickels, Wallace Christopher, 41, Cheapside, E.C.
1892			Nickolls, John Bate, The Royal Societies Club, St. James's-street, S.W.
1883	Trans.		Nicol, William Walker James, M.A., D.Sc. (Edin.), F.I.C., 15, Blacket-place, Edinburgh
1900			Nightingale, Thomas Marginson, B.Sc. (Vict.), 375, Bridgman-street, Bolton
1898			Nightscales, Thomas Arthur, 2, St. James'-parade, Hull
1894			Nixon, Alfred, 7, Oak-road, Sale, Manchester
1869			Noble, Sir Andrew, Bart., K.C.B., D.C.L. (Dunelm), F.R.S., Jesmond Dene House, Newcastle on-Tyne
1903	Trans.		Norman, George Marshall, B.Sc. (Lond.), A.R.C.S., A.I.C., 2, Bartholomews, Brighton
1889			Norman, John T., Avalon, Putney Common, S.W.
1861			Norrington, Frederick, 5, Downfield-road, Clifton, Bristol
1892			Norris, Charles James, 31, Airedale-avenue, Chiswick, W.
1897	Trans.		North, Barker, Glenholme, Glenholme-road, Manningham, Bradford
1899	Trans.		Northall-Laurie, Dudley, F.I.C., King's College, Strand, W.C.
1892			Northing, John, The Murrough, Wicklow
1854			Norton, Fletcher, Longtown, Abergavenny
1878			‖Norton, Thomas Herbert, Prof., Ph.D., D.Sc., c/o The John Crerar Library, Chicago, Ill., U.S.A.
1901			Nunn, Arthur W., 68, Catford Hill, S.E.
1904			Oakden, William Edward, 2, Gledhow-terrace, South Kensington, S.W.
1893	Trans.		Oates, William Henry, Broomhall-park, Sheffield
1903			O'Brien, Frederick, 9, Elvaston-road, Victoria-park, Bedminster, Bristol
1902			O'Connor, Sinnott Valentine, 14, Selskar-street, Wexford
1890			Oddy, Robert Walter, F.I.C., Waterhouse, Toad-lane, Rochdale
1873			‖Odling, Walter, F.I.C., c/o Messrs. Bass and Co., Burton-on-Trent
1848	Trans.	S. 1856-69 V.P. 1869-73, P. 1873-5	Odling, William, Prof., M.A. (Oxon.), M.B. (Lond.), F.R.C.P., F.R.S., 15, Norham-gardens, Oxford
1905			O'Farelly, Alfons, M.A. (R.U.I.), 3, Holles-street, Dublin
1902			Ogilvie, Allan, Frodingham House, Frodingham, near Doncaster
1901			Oldershaw, William, Strelley, Nottingham
1904			Oldfield, Laurel Cecil Francis, Lincoln College, Oxford
1889			O'Mahony, D. J., Municipal-buildings, Anglesea-street, Cork
1901			Oram, Frank, Market-place, Romsey

Date of Election.			
1890	Trans.		Ormandy, William Reginald, c/o Crossfield's Soap Works, Warrington
1869			‖Orme, Temple A., University College, W.C., and 213, Uxbridge-road, W.
1872			‖Ormerod, Joseph Arderne, M.D. (Oxon.), M.R.C.S. (Eng.), F.R C.P. (Lond.), The Medical Committee Room, St. Bartholomew's Hospital, E.C.
1887			‖Ormiston, Archibald R., Braeholm, Helensburgh; and 203, St. Vincent-street, Glasgow
1893			Orr, Alexander, Norwich-chambers, 35A, Bligh-street, Sydney, N.S.W.
1881			Orr, John Bryson, Chestnut Lodge, Widnes, Lancs.
1884	Proc.		Orsman, William James, F.I.C., Chemical Laboratory, Gathurst, near Wigan
1897	Trans.		Orton, Kennedy Joseph Previté, Prof., M.A. (Cantab.), Ph.D. (Heidelberg), F.I.C., Llwyn Eithin, and University College of North Wales, Bangor
1881	Trans.		O'Shea, Lucius Trant, B.Sc., c/o Mrs. O'Shea, The Cottage East Cosham, Hants.
1887			Ostersetzer, Julius, F.I.C., c/o Messrs. W. and H. M. Goulding, Manure Manufacturers, North Wall, Dublin
1876	Trans.	C.1882-6 V.P.93-6	†O'Sullivan, Cornelius, F.R.S., F.I.C., 148, High-street, Burton-on-Trent
1883	Trans.		O'Sullivan, James, F.I.C., High Bank, Burton-on-Trent
1899			O'Sullivan, John, 1461, Georgia-street, Vancouver City, B.C.
1887			‖O'Sullivan, Patrick Thomas, M.D., B.Ch. (R.U.I.), B.C.L., 20, South Mall, Cork
1891			Ough, Lewis, Fernleigh, St. James's-road, Leicester
1888			Overbeck, Otto C. J. G. L., Chantry House, Great Grimsby
1887			‖Overend, Frederick Lawrence, B.A. (Oxon.), 98, Rowley-street, Walsall
1871	Trans.	C. 1889-94	‖Page, Frederick James Montague, B.Sc. (Lond.), A.R.S.M., F.I.C., 54, Sutherland-street, Pimlico, S.W.
1904			Page, William Davidge, Hotel Russell, Russell Square, W.C.
1898	Trans.		Pakes, Walter Charles Cross, M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Cantab.), F.I.C., The Government Laboratories, P.O. Box 1080, Johannesburg, South Africa
1884			‖Pallister, John William, B.Sc., 107, Waverley-road, Bradford
1882			Palmer, Alfred Neobard, Ingle Nook, Bersham-road, Wrexham
1888			Palmer, Henry John, Summerleaze, Yelverton, R.S.O., Devon

† Longstaff Medallist, 1884.

Date of Election.			
1899			Palmer, Thomas Henry, "Amalfi," Longueville, Sydney, N.S.W.
1879			Palmer, Walter, M.P., The College, Reading, and 50, Grosvenor-square, W.
1902			Panisset, Sydney Glyde Stephen, 3, Weston-road, Strood, Kent
1899	Trans.		Panting, Laurence Christopher, M.A., M.D., B.Ch. (Oxon.), 45, Lemon-street, Truro
1900			Pardy, Alexander, Central Experiment Farm, Cedara, Natal, South Africa
1898			Parker, Alfred James, 43, Harcourt-street, Blackburn, Lancs.
1897			Parker, Charles Henry, Merrills House, March End, Wednesfield
1882			Parker, Joseph R., Avondale, 129, Kyverdale-road, Stoke Newington, N.
1894	Trans.		Parker, Matthew Archibald, Prof., B.Sc. (Glas.), University of Manitoba, Winnipeg, Canada
1882			‖Parker, R. H., 35, Clifton-road, Maida Vale, W.
1901			Parkes, Albert Edward, F.I.C., Chemical Laboratory, 43, Whitehorse-street, Stepney, E.
1890			Parkes, Thomas, M.A. (Cantab.), 2, Gawber-road, Barnsley
1865	Trans.		‖Parkinson, James, F.G.S., Queen's-chambers, Pirie-street, Adelaide, South Australia
1893			Parrish, S., 80, Grange-avenue, Chapeltown-road, Leeds
1892			Parry, Ernest John, B.Sc. (Lond.), F.I.C., 208, High-street, Borough, S.E.
1903			Parry, George Harry, The Level, Brierley Hill, Staffs.
1904			Parry, William, B.Sc. (Lond.), 31, Mount Pleasant, Waterloo, Liverpool
1870			Patchett, Isaac, F.I.C., 11, Osborne-terrace, Field-hill, Batley
1894	Trans.		Paterson, David, F.R.S.E., Lea Bank, Rosslyn, Midlothian, N.B.
1885	Trans.		Patterson, George, F.I.C., The Manbré Saccharine Co., Hammersmith, W.
1896			Patterson, Joseph W., 14, Mitchell-street, W. Hartlepool, Durham
1870	Trans.		Patterson, Thomas Law, F.I.C., Maybank, Finnart-street, Greenock
1904	Trans.		Patterson, Thomas Stewart, Ph.D. (Heidelberg), Chemical Department, The University, Glasgow
1863	Trans.	{ V.P. 1891-4 }	Pattinson, John, F.I.C., 10, Dean-street, Newcastle-on-Tyne
1868	Trans.		‖Paul, B. H., Ph.D., Analytical Laboratory, 13, Fenchurch-street, E.C., and Parkside, Kingston Vale, Putney, S.W.
1885	Trans.		Paul, Lewis Gordon, Ph.D. (Tübingen), F.I.C., Market Hall-chambers, King-street, Huddersfield
1901			Pay, Walter Herbert, Government Laboratory, Durban, Natal
1896			Payne, Arthur, c/o Messrs. Mawson and Swan, Moseley-street, Newcastle-on-Tyne

Date of Election.			
1893			Payne, George F., M.D., 43½, Whitehall-street, Atlanta, Georgia, U.S.A.
1899	Trans.		Peachey, Stanley John, School of Technology, Whitworth-street, Manchester
1901			Peacock, Arthur, B.Sc. (Vict.), 11, Francis-street, Heckmondwike, Yorks.
1900			Pearce, Ernest Vivian, The Hollies, Hayle, Cornwall
1874			Pearce, William, Chemical Works, Bow Common, E.
1894	Trans.		Pearson, William Henry, 6, Fenchurch-buildings, E.C.
1902			Peck, John Wicliffe, 28, West Ella-road, Harlesden, N.W.
1894			Peden, John, jun., Chemical Laboratory, 11, Duff-street, Greenock
1870	Trans.		‖Pedler, Alexander, Prof., C.I.E., F.R.S., F.I.C., Director of Public Instruction, Writer's-buildings, Calcutta, India
1904			Pell, Alfred, 44, Cumballa-hill, Bombay, India
1886	Proc.		Pendlebury, William Henry, M.A. (Oxon.), Woodford House, Mountfield, Shrewsbury
1870			Penney, M. D., 11, High-street, Hull
1895			Pennington, William Henry, Field House, Rochdale
1905			Pennycuick, Thomas, B.Sc. (Lond.), 6, Lorne-street, Fairfield, Liverpool
1886			Pentecost, Stephen James, Nottingham-road, New Basford, Notts.
1889	Trans.		Percival, John, M.A. (Cantab.), The University College, Reading
1884	Trans.		Perkin, Arthur George, F.R.S., F.I.C., 8, Montpelier-terrace, Hyde Park, Leeds
1891	Trans.		Perkin, Frederick Mollwo, Ph.D., Borough Polytechnic, Borough-road, S.E.
1856	Trans.	C. 1861-2 1868-9 S. 1869-83 P. 1883-5	†‖Perkin, William Henry, Hon. LL.D. (St. Andrews), Hon. Ph.D. (Würzburg), Hon. D.Sc. (Vict.), F.R.S., F.I.C., The Chestnuts, Sudbury, Harrow
1884	Trans.	C. 1891-5.	*Perkin, William Henry, jun., Prof., Ph.D. (Würzburg), F.R.S., F.I.C., Fairview, Wilbraham-road, Fallowfield, Manchester
1890	Trans.		‖Perman, Edgar Philip, D.Sc., University College, Cardiff
1905			Perrott, Bert, Ael-y-Bryn, Penywern-road, Neath, Glam.
1888			Perry, George Edward, 103, Stirling-road, Edgbaston, Birmingham
1900			Pettigrew, Robert, 44, Mosley-street, Manchester
1903			Phelps, John, B.A. (Oxon.), 9, Hawes-road, Bromley, Kent
1881			Philip, Arnold, B.Sc. (Lond.), A.R.S.M., F.I.C., Chemical Laboratory, H.M. Dockyard, Portsmouth
1897	Trans.		Philip, James Charles, B.Sc. (Aberd.), Ph.D. (Göttingen), Royal College of Science, South Kensington, S.W.

† Longstaff Medallist, 1888.
* Longstaff Medallist, 1900.

Date of Election.			
1887			Phillips, Arthur Gaved, A.R.S.M., F.I.C., 11, Essex-villas, Phillimore-gardens, Kensington, W.
1889			Phillips, Benjamin, 5, Staunton-road, Poona, India
1905			Phillips, George Frederick Tyler, B.Sc. (Lond.), University College, Southampton
1897			Phillips, Harry Edward William, B.A. (Oxon.), The Laurels, Eynsham, Oxford
1882			Phillips, Henry Harcourt, Lynwood, Turton, Lancs.
1902	Trans.		Phillips, Percy Philip, Ph.D. (Göttingen), Thomason Engineering College, Rurki, North-West Provinces, India
1900			Phillpotts, Geoffrey Surtees, B.A. (Cantab.), 82, James-street, Dublin
1897	Trans.		‖Pickard, Robert Howson, D.Sc. (Lond.), Ph.D. (Munich), B.Sc. (Birm.), F.I.C., Municipal Technical School, Blackburn
1891			Pickering, Michael Samuel, B.Sc. (Lond.), 38, Price-street, Burslem
1878	Trans.	C. 1886-7 89-93 1901-04	‖Pickering, Spencer Percival Umfreville, M.A. (Oxon.), F.R.S., F.I.C., Harpenden, Herts.
1890	Trans.		‖Picton, Harold, B.Sc. (Lond.), Clacton College, Clacton-on-Sea
1894			Pike, E. Brooke, Grasmere, 515, Romford-road, Forest Gate, E.
1904			Pike, Henry George, College of Agriculture, Downton, Salisbury, Wilts.
1874	Trans.		‖Pike, William Herbert, Prof., Ph.D., Sandhills, Salcombe, Kingsbridge, Devon
1883			‖Pilley, John J., Ph.D., 167, Camberwell-grove, S.E.
1896			Pilley, Thomas William, 33, Grove-hill-road, Denmark Hill, S.E.
1904			Pinchbeck, Gerald, 96, Albany-street, Regent's Park, N.W.
1889			Ping, William, 14, Selsdon-road, Wanstead, N.E.
1889			Pingstone, George Arthur, Bulawayo Public Analyst, P.O. Box 445, Bulawayo, South Africa
1904			Pinkerton, David John, Dalzell Steel and Iron Works, Motherwell, N.B.
1881			Pisani, O. V., Effingham House, Arundel-street, Strand, W.C.
1903	Trans.		Pitt, Arthur Ernest, 66, Abbott-road, Bromley, E.
1903			Pitt, Harold Russell, 8, Church-lane, Charlton, S.E.
1882			Pitt, Theophilus, 16, Coleman-street, E.C.
1899			Pittuck, Frederick Williams, St. Nicholas' Buildings West, Newcastle-on-Tyne
1899			Pizey, James Henry, A.R.C.S., A.I.C., Anchor Chemical Works, Provanmill, Glasgow
1893			Platt, Charles, M.D., Ph.D., Hahnemann Medical College, Philadelphia, U.S.A.

Date of Election.			
1860			‖Player, J. H., 16, Prince Arthur-road, Hampstead, N.W.
1899	Trans.		‖Plimmer, Robert Henry Aders, D.Sc. (Lond.), 3, Hall-road, N.W.
1903			Plymen, George Horace Gladstone, The Bulwarks, St. Aubyn, Jersey
1899			Polkinghorne, Bennett C., B.Sc., 17, Humber-road, Blackheath, S.E.
1888	Trans.		Pollard, Frederick Ernest, F.I.C., 14, Old Hall-street, Hertford
1898			Pollard, William, B.A., Ph.D., The Museum, Jermyn-street, S.W.
1904			‖Pollard, William Branch, B.A. (Cantab.), Survey Department, Public Works Ministry, Cairo, Egypt
1902			Pollitt, George Paton, B.Sc. (Vict.), Ph.D. (Bâle), Winnington, Northwich, Cheshire
1901			Pollitt, Charles James Tomlin, c/o Messrs. Kynoch, Ltd., Witton, near Birmingham
1896			Pollitt, Robert Barnabas, F.I.C., c/o The De Beers Explosive Works, Cape Town, South Africa
1897			Pollitt, Samuel, B.Sc. (Vict.), "Oak Lawn," Holly-park, Crouch Hill, N.
1894	Trans.		‖Pollok, James Holms, B.Sc. (Glas.), Royal College of Science, Stephen's-green, Dublin
1903			Pond, George Gilbert, Prof., M.A., Ph.D. (Amherst), Pennsylvania State College, Pennsylvania, U.S.A.
1890			Pond, James Alexander, Auckland, New Zealand
1899			Ponthieu, Georges, c/o Messrs. Parke, Davis & Co., Detroit, Mich., U.S.A.
1848			Pontifex, Edmund A., M.I.C.E., 6, Cadogan-court-gardens, Cadogan-place, S.W.
1898	Trans.		Pope, Thomas Henry, B.Sc., A.C.G.I., F.I.C., Brewing School, The University, Birmingham
1891	Trans.	C. 1900-2	†Pope, William Jackson, Prof., F.R.S., F.I.C., 16, Hope-street, Higher Broughton, Manchester
1903			Porter, Robert James, 11, Arlington-street, Hull
1884	Proc.		‖Porter, Thomas Cunningham, M.A. (Oxon.), Upton-park, Slough
1904			Porter, Thomas Linton Daniel, D.Sc. (Lond.), 161, Downsell-road, Stratford New Town, E.
1895			Potter, Arthur Edward, M.A. (Cantab.), B.Sc. (Lond.), Rangoon, Burma, India
1883			Potter, Charles Edward, c/o Messrs. Tate and Sons, Love-lane Sugar Refinery, Liverpool
1901			Potter, Rowland Samuel, 97, Belgrave-road, Cranbrook-park, Ilford, E.
1896			Potts, Henry William, Hawkesbury Agricultural College, Richmond, N.S.W.

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† Longstaff Medallist, 1903.

Date of Election.			
1895			Powell, Harry James, 530, Lordship-lane, S.E.
1896	Trans.		Power, Frederick Belding, Ph.D. (Strassburg), 6, King-street Snow-hill, E.C.
1884			‖Power, Francis R., The Royal Mint, Melbourne, Australia
1902			Powney, William E. F., 9, Lancaster-road, Stroud Green, N.
1904	Trans.		Prentice, Bertram, Ph.D. (Munich), D.Sc. (Edin.), Roya Technical Institute, Salford
1902			Přibram, Richard, Prof., Celabowsky-Parb, 6, Prague, Bohemia
1882			‖Price, A. F., 2503, Broadway, San Francisco, Cal., U S.A.
1899			Price, Robert Coleman, Prof., The Miller School, P.O., Albemarl Co., Virginia, U.S.A.
1901	Trans.		Price, Thomas Slater, D.Sc. (Lond. and Birm.), Ph.D. (Leipzig) A.I.C., Chemical Department, Municipal Technical Colleg Suffolk-street, Birmingham
1903			Prichard, George Montague, Ramtek, Nagpur, C.P., India
1889			‖Priestley, Charles W., B.Sc., Cotesleigh, Torquay
1870			Pritchard, William, Prof., President Royal Veterinary College N.W., and 5, Regent's Park-road, Gloucester-gate, N.W.
1871	Trans.		‖Procter, Henry Richardson, Prof., F.I.C., The University, Leeds and Rowangarth, Ben Rhydding, viâ Leeds
1889	Trans.		Proctor, Charles, F.I.C., 27, London-road, Forest Hill, S.E.
1896	Proc.		Proude, James, 30, Cromwell-terrace, Halifax
1897			Pullar, Herbert Spindler, Pullar's Dye Works, Perth, N.B.
1882			‖Pullar, Rufus D., Brahan, Perth
1902			Puntan, Herbert Harding Cruikshank, Borough Analyst London-chambers, Durban, Natal
1875	Trans.	C. 1888-92 V.P.1899-1902	Purdie, Thomas, Prof., Ph.D. (Würzburg), Hon. LL.D (Aberd.), B.Sc. (Lond.), F.R.S., A.R.S.M., F.I.C., Th University, St. Andrews, N.B.
1901			Purvis, John Edward, M.A. (Cantab.), A.R.C.S.I., F.I.C. University Chemical Laboratory, Cambridge
1886			Pyke, Lazarus S. M., M.I.C.E., 10, Westbourne-terrace, Hyd Park, W.
1905			Pyman, Frank Lee, B.Sc. (Vict.), Ph.D. (Bâle), The Oaks Hitchin, Herts.
1905			Quant, Ernest, 2, Park-crescent, Torquay
1868			Quibell, Oliver, Shalem Lodge, Newark
1894			Quinn, Gerald G., 8, Church-view, Norden, Rochdale

Date of Election.			
1901			Radcliffe, Lionel Guy, 6, Alma-terrace, Old Trafford, Manchester
1902			Ralphs, Edwin, Queen's College, Hong Kong
1897			Ralston, William, B.Sc. (Lond.), F.I.C., 3, Windsor-terrace, Linthouse, Govan, Glasgow
1892	Trans.		‖Ramage, Hugh, B.A. (Cantab.), A.R.C.S.I., F.I.C., Ridgemont, Carrow-hill, Norwich
1873	Trans.	C. 1886-9 V.P. 92-5, 1897-1900 F.S. 1902-	†‖Ramsay, Sir William, K.C.B., Ph.D. (Tübingen), Hon. LL.D. (Glas.), Hon. Sc.D. (Dub.), Hon. D.Sc., (Cantab. and Columbia), F.R.S., F.I.C., University College, W.C., and 19, Chester-terrace, Regent's Park, N.W.
1901			Ramsden, William Cecil, 107, Moyne-road, Rathmines, Dublin
1902			Ramshaw, Walter, 16, High-street, Shaftesbury
1885			Ranken, Charles, Stockton-road, Sunderland
1889			Ransom, Francis, The Chilterns, Hitchin
1898			Ratcliffe, Walter, 21, Mawdsley-street, Bolton
1905			Ratcliffe, William Henry, B.Sc. (Lond.), Westcombe, Loampit-hill, St. Johns, S.E.
1880			‖Rawson, Christopher, F.I.C., 2, Melbourne-place, Bradford
1884	Trans.		‖Rawson, Sidney George, D.Sc. (Lond.), F.I.C., Red Hill House, London-road, Worcester
1898			Ray, John Armstedt, jun., B.A. (Dub.), 15, Nassau-street, Dublin
1902	Trans.		Rây, Prafulla Chandra, Prof., Presidency College, Calcutta
1889	Trans.		‖Read, Arthur Avery, F.I.C., 3, Fitzalan-place, Cardiff
1895			Read, Edwin James, B.A. (Cantab.), F.I.C., St. Ives, The Avenue, Gravesend, Kent
1899	Trans.		Read, Harold McLean, North Lodge, 173, Castlenau, Barnes, S.W.
1900			Readman, James Fraser, 50, Jane-street, Glasgow
1890			Redding, Richard James, 29, Isla-road, Plumstead, Kent
1904			Redfern, Herbert Stanley, B.Sc. (Vict.), U.M.F.C. College, Ningpo, China
1892			Redman, Henry Ramsden, 60, Nelson-road, Gillingham, Kent
1866		C. 1891-2	Redwood, Sir Boverton, Hon. D.Sc. (Ohio), F.R.S.E., F.I.C., 4, Bishopsgate-street-within, E.C.
1889			Redwood, Robert, 4, Bishopsgate-street-within, E.C.
1887			Redwood, Theophilus Horne, F.I.C., 15, Red Lion-square, W.C.
1886	Trans.		Rée, Alfred, Ph.D. (Berne), 15, Mauldeth-road, Withington, Manchester
1882	Proc.		Reed, Lester, F.I.C., Hyrsthof, 8, South Park-hill-road, South Croydon
1880			‖Regester, William, Lawn Lodge, Isleworth, Middlesex
1897			Reid, Alexander Ferguson, The Gold and Silver Extraction Co., Ltd., 208–210, McPhee Building, Denver, Col., U.S.A.

† Longstaff Medallist, 1897.

Date of Election.			
1893			Reid, Thomas Anderson, c/o Messrs. Johnsen, Jörgensen, and Wettre, 38, Victoria-buildings, Manchester
1881			‖Reid, Walter Francis, F.I.C., Fieldside, Addlestone, Surrey
1897			Remington, John Stewart, Aynsome, Grange-over-Sands, Carnforth, Lancs.
1886			Remington, Joseph Price, Prof., 1832, Pine-street, Philadelphia, U.S.A.
1879	Trans.		Rennie, Edward Henry, Prof., D.Sc. (Lond.), F.I.C., The University, Adelaide, S. Australia
1898	Proc.		Renwick, Frank Forster, Hylands, Brentwood, Essex
1902	Trans.		Revis, Cecil, 77, King-street, Hammersmith, W.
1873	Trans.	V.P. 1881-4, 89-92, 97-1900. P. 1901-1903	Reynolds, James Emerson, Prof., Hon. Sc.D., Hon. M.D. (Dub.), L.R.C.S., L.R.C.P. (Edin.), F.R.S., F.I.C., 29, Campden Hill Court, Kensington, W.
1898	Trans.		Reynolds, William Colebrook, B.Sc. (Lond.), Roseleigh, Essex-road, Dartford, Kent
1903			Rhind, Thomas, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 69, Gloucester-road, Regent's Park, N.W.
1898	Trans.		Rich, Edward Milton, 18, Manor-road, Forest Hill, S.E.
1903			Rich, Stiles William George, c/o Messrs. Thomason Chater, Ltd., Stanley-street, South Brisbane, Queensland
1889			Richards, Duncan Taylor, 57, Osborne-avenue, Westoe-lane, South Shields
1889			‖Richards, Edgar, c/o G. K. Richards, Esq., 16, Lafayette-square, Washington, D.C., U.S.A.
1905			Richards, Frederick George, 21 Dutton-street, Manchester
1889			‖Richards, Percy Andrew Ellis, F.I.C., 51, Rowan-road, Brook Green, W.
1886			Richards, William, B.Sc. (Lond.), The Clock House, Tooting, S.W.
1898			Richards, William, Flora Cottage, Eastbourne, Darlington
1885	Trans.		‖Richardson, Arthur, The Central Hindu College, Benares, N.W.P., India
1888	Trans.		‖Richardson, Clifford, Director, New York Testing Laboratory, Long Island City, New York, U.S.A.
1883			Richardson, Frederic William, F.I.C., Oak Lea, Menston, Leeds
1903			Richardson, Harold Ernest, B.A., B.Sc. (Lond.), 63, Lansdowne-road, Seven Kings, Ilford, Essex
1873			Richardson, Henry, Lyndene, Hale-road, Bowdon, Cheshire
1888			Richardson, Hubert N. B., 10, Friar-lane, Leicester
1866			Richardson, Joseph, Pansei View, Arran-avenue, Marsland-road, Sale, Manchester
1892			Richardson, Reginald Edensor Stanley, 10, Friar-lane, Leicester
1887	Trans.		Richmond, Henry Droop, F.I.C., 8, Woodfield-road, Ealing, W.

Date of Election.			
1903			Ricketts, Guy Dunstan, M.A. (Cantab.), The University, Birmingham
1894			Riddick, David Gibson, Stores Department, G.E.R., Stratford, E.
1882	Trans.		‖Rideal, Samuel, D.Sc. (Lond.), F.I.C., 28, Victoria-street, Westminster, S.W.
1895			Ridge, W. T. B., 2, Ashwood-terrace, Longton, Staffs.
1882	Trans.		Ridsdale, Charles Henry, F.I.C., Ferndale, Linthorpe, Middlesbrough
1888			Rigby, John S., 26, Bagot-street, Wavertree, Liverpool
1898			Rigg, Gilbert, 4, Park-road, Accrington
1851	Trans.	C. 1878-80	Riley, Edward, F.I.C., 14A, Finsbury-square, E.C.
1904			Riley, Louis John Eezekiel, A.I.C., 8, Newton-road, W.
1900			Riley, Walter A., Brunswick Lodge, Newmarket-road, Norwich
1893			Rintoul, William, F.I.C., Royal Gunpowder Factory, Waltham Abbey
1902			Roast, Harold James, Y.M.C.A., Montreal, Quebec, Canada
1893			Robbins, James Henry, B.Sc., 4, Selborne-road, Ilford, Essex
1897			Roberts, Ernest Henry, 81, Cicada-road, Wandsworth, S.W.
1883			‖Roberts, Frederick George Adair, Chemical Works, Carpenter's-road, Stratford, E.
1899			Roberts, James, jun., 43, Great Western-road, Glasgow
1902			Roberts, Jonathan Hugh, Jamaica College, Kingston, Jamaica
1876			Roberts, Martin Fenn, General Post Office, E.C., and Mabshill, Epsom.
1889			Roberts, Richard Wightwick, c/o A. W. Rowe, Esq., Dashwood House, 9, New Broad-street, E.C.
1894			Roberts, Thomas John, Ingleside, Park-road, Huyton, nr. Liverpool
1880			Roberts, William Brittain, Wilderspool House, Warrington, Lancs.
1894			Robertson, A. B., Struan, Giffnock, Glasgow
1904			Robertson, Franklin Ernest, Gloster House, Harders-road, Peckham, S.E.
1903			Robertson, Frederick, 120, Wellington-street, Glasgow
1904	Trans.		Robertson, Philip Wilfred, A.M. (Wellington), Trinity College, Oxford
1901	Trans.		Robertson, William, 9, Thirsk-road, Lavender Hill, Battersea, S.W.
1889			Robins, Harry Hollis, c/o Messrs. Southwell and Co., Dockhead, S.E.
1903			Robinson, Archibald Louis, B.A. (Dub.), 40, Trinity College, Dublin
1896			Robinson, Henry Fishwick, M.Sc. (Vict.), 2, Richmond-street, Droylsden-road, Newton Heath, Manchester
1882	Trans.		‖Robinson, Henry Haliburton, M.A. (Oxon.), F.I.C., 75, Finborough-road, West Brompton, S.W.

Date of Election.			
1895			Robinson, Herbert Lewin, The Plating Co., 10, Kirby-street, Hatton-garden, E.C.
1901			Robinson, William Hammond, Ribblesdale, Cardiff-road, Llandaff, South Wales
1904			Rodger, Robert, 54, Rostrevor-road, S.W.
1898			Rofe, Henry John, M.A. (Oxon.), 8, Victoria-street, Westminster, S.W.
1883			Rogers, Arthur William, Tadcaster Tower Brewery Co., Tadcaster
1884			Rogers, Francis M., 21, Burma-road, Stoke Newington, N.
1905			Rogers, Harold Rudolf, B.A. (Oxon.), 75, South Side, Clapham Common, S.W.
1904			Rogers, William David, A.R.C.S., A.I.C., 36, Grange-road, Smethwick
1894			Rolfe, John F., Rock Mount, Whalley-road, Accrington
1903			Roose, Fitzroy Owen Jonathan, A.I.E.E., Brinklea, Wimborne-road, Bournemouth
1855	Trans.	C. 1860-4 1871-3. V.P. 73-5 1877-80. P. 80-2	Roscoe, Sir Henry Enfield, LL.D. (Cantab.), D.C.L. (Oxon.), Hon. M.D. (Heidelberg), Hon. D.Sc. (Vict.), Ph.D., F.R.S., 10, Bramham-gardens, South Kensington, S.W.
1891	Trans.	C. 1897-8	‖Rose, Thomas Kirke, D.Sc. (Lond.), 6, Royal Mint, E.
1896	Trans.		Rosenheim, Otto, Ph.D. (Würzburg), 68, Belsize-park-gardens, N.W.
1894			Ross, Arthur, F.I.C., 1, Glengall-road, Old Kent-road, S.E.
1905			Ross, Frederick Wilson Montrose, 21, Soho-square, W.
1903			Ross, George Archibald Park, M.B., Ch.B. (Edin.), D.P.H., 69, Leamington-terrace, Edinburgh
1881			Ross, Henry, Rev., LL.D., Dallas House, Lancaster
1870			Ross, Lewis Buttle, Driffield, Yorks.
1896			Ross, Raymond St. George, F.I.C., Public Analyst, Burnley
1902			Ross, William Charles, Capt., I.M.S., M.B., Ch.B., D.P.H. (Edin.), Purulia, Bengal, India
1891	Proc.		Rossiter, Edmund Charles, F.I.C., 4, Park-road, West Smethwick, Birmingham
1896			Rostron, Harold, B.Sc. (Vict.), 202, Tonge Moor-road, Bolton
1892			Rothwell, Charles Frederick Seymour, Beech Croft, Mobberley, Knutsford
1905			Rouillard, Marie Jean Louis Ernest, B.Sc. (Edin.), Malvern, Natal, South Africa
1899			Roundell, Christopher Foulis, B.A. (Oxon.), Lieut., Guards' Club, Pall Mall, S.W.
1900			Row, M. C. Nanjunda, B.A., M.B., C.M. (Madras), Mylapore, Madras, India

Date of Election			
1894			Rowntree, Walter Smithson, B.Sc., F.L S., Leighton-park, Reading
1900			Roy, M. Goolab, Chintadirpetah, Madras, India
1901			Royle, Charles Leonard, c/o Messrs. Parry & Co., Madras, India
1862			‖Royle, Thomas, F.I.C., 329, Upton-lane, Forest Gate, E.
1872	Trans.		Ruffle, John, F.I.C., Musley, Ware, Herts.
1895			Rugginz, William Augustus, "Strathmore," 14, Empress-avenue, Cranford-park, Ilford, Essex
1889	Trans.	C. 1903-05	Ruhemann, Siegfried, M.A. (Cantab.), Ph.D. (Berlin), Gonville and Caius College, Cambridge
1883			Rumble, Charles, F.I.C., 9, Sangora-road, New Wandsworth, S.W.
1890			‖Russell, Edward, B.Sc. (Lond.), F.I.C., 55, St. Ronan's-road, Southsea
1899	Trans.		Russell, Edward John, D.Sc. (Lond.), S.E. Agricultural College, Wye, Kent
1901			Russell, James Bertram, B.Sc. (Lond.), 46, Spencer-avenue, Wood Green, N.
1851	Trans.	C. 1863-7, 1870-2. V.P. 1872-3 S. 1873-5 T. 1875-89 P. 1889-91	‖Russell, William James, Ph.D. (Heidelberg), F.R.S., F.I.C., 34, Upper Hamilton-terrace, St. John's Wood, N.W.
1896			Rutter, Thomas Francis, B.Sc. (Lond.), 120, Upper Tulse Hill, S.W.
1894			Ryce, George, B.A. (R.U.I.), Irish Agricultural Offices of the Potash Syndicate, 50, Essex-street, Dublin
1901	Trans.		Ryffel, John Henry, M.A. (Cantab.), B.Sc. (Lond.), 10, Grasmere-road, Muswell Hill, N.
1888			‖Sach, Albert John, Technical College, Goulburn, N.S.W.
1868			Sadler, Sir Samuel Alexander, Col., M.P., Cleveland Chemical Works, Middlesbrough
1896			Sage, Charles Edward, 2, Charterhouse-street, E.C.
1879	Trans.		‖Sakurai, Joji, Prof. Science College, Imperial University, Tokio, Japan
1880			Salamon, Alfred Gordon, A.R.S.M., F.I.C., 2, Belgrave-place, Belgrave-square, S.W.
1876			‖Salomons, Sir David Lionel, Broomhill, Tunbridge Wells; and Berkeley Chambers, 13, Bruton-street, Hyde Park, W.
1896			Salt, Arthur Phillip, Rosecroft, St. James-road, Sutton, Surrey
1863			‖Salt, Henry, M.D., C.M. (Edin.), F.R.G.S., Inglewood, Great Malvern
1871			‖Salter, Mortyn John, F.I.C., Greyrickhouse, Mickleton, Glos.

Date of Election.		
1859		‖Salter, Thomas W., 193, Priory-road, West-hill, Hastings
1903		Sampson, John William, Cleveland Pharmacy, Bath
1903		Samuel, Thomas, B.A. (Lond.), School of Science & Art, Liscard, Cheshire
1882		Samuel, William Cobden, Elmdale, 66, Croxted-road, West Dulwich, S.E.
1898	Trans.	Sand, Henry Julius Salmon, Ph.D. (Zürich), University College, Nottingham
1870		‖Sandberg, Christer P., Palace-chambers, 9, Bridge-street, Westminster, S.W.
1900		Sanders, James McConnell, c/o Direccion General de Aduanas, Mexico
1904		Sanders, Percy Richard, West Cliffe, Seaford, Sussex
1888		Sanderson, John, F.I.C., c/o Messrs. B. S. Cohen, Ltd., 15, Clerkenwell-close, E.C.
1900		Sandford, James Wallace, c/o Messrs. A. W. Sandford and Co., Grenfell-street, Adelaide, South Australia
1901		Sandford, Thomas, 8, Market-street, Dalton-in-Furness
1882		Sanford, Percy Gerald, F.I.C., Laboratory, 20, Cullum-street, E.C.
1890		Saniter, Ernest Henry, Strafford Villa, Moorgate, Rotherham
1891		Sanyal, Abhayacharan, M.A. (Calcutta), Professor of Physical Science, Queen's College, Benares, N.W.P., India
1892		Sarbadhicary, Satya-prasad, 1, College-street, Calcutta
1900		Sargeant, Fred. Pilkington, College of Pharmacy, Clarendon-road, Leeds
1886		Saunders, William, Prof., Experimental Farm, Ottawa, Ontario, Canada
1896		Saville, Arthur Edwin, Gas Works, Gas-street, Bolton
1903		Sawdon, Ernest William, B.Sc. (Vict.), 2, Esk-terrace, Whitby
1898		Sayer, Harold Charles, 51, Highfield-road, Dartford
1890		Sayers, William Charles, 63, High-street, Lewisham, S.E.
1885		Scammell, Luther R., 42–4, King William-street, Adelaide, South Australia
1877		Scarf, Isaac Sydney, F.I.C., City of London College, White-street, Moorfields, E.C.; and 75, Oxford-road, Canonbury, N.
1897		Scargill, Lionel Walter Kennedy, B.A. (Oxon.), 5, Tenison-avenue, Cambridge
1893		Schidrowitz, Philip, Ph.D. (Berne), 57, Chancery-lane, W.C.
1888	Trans.	‖Schieffelin, William Jay, Ph.D., 840, Southern-boulevard, New York, U.S.A.
1892		‖Schofield, James Alexander, A.R.S.M., F.I.C., The University, Sydney, N.S.W.
1903		Scholefield, Alfred Henry, B.A., B.Sc. (Lond.), 57, The Avenue Leigh, Lancs.

Date of Election.			
1905	Trans.		Scholefield, Fred, B.Sc. (Lond. and Vict.), A.I.C., 9, Lyndhurst-villas, Magdalen-road, Norwich
1902			Scholes, William, 100, Victoria-street, Radcliffe, Lancs.
1899	Trans.		Schryver, Samuel Barnett, D.Sc. (Lond.), Ph.D. (Leipzig), 27, Arundel-gardens, Notting Hill, W.
1896			Scotland, Peter B., c/o The Arizona Copper Co., Ltd., Metcalf Mines, Clifton, Arizona, U.S.A.
1879	Trans.	C.1897-9 S. 1899-1904 T 1904-	‖Scott, Alexander, M.A. (Cantab.), D.Sc. (Edin.), F.R.S., F.I.C., Davy-Faraday Research Laboratory, 20, Albemarle-street, W.
1890			Scott, Ernest George, 2, Talbot-court, Gracechurch-street, E.C.
1901			Scott, George Charlton, Bengal Iron and Steel Co., Ltd., Burrakur, Bengal, India
1905			Scott, John Irwin, B.A. (Oxon.), Trent College, Long Eaton, Derbyshire.
1883	Proc.		Scudder, Frank, F.I.C., 44, Mosley-street, Manchester
1896			Seabrooke, Herbert Cecil, F.I.C., "Black Ash," Grays, Essex
1891			Searl, Albert, Montreux, Victoria-road, Sidcup, Kent
1890			Seaton, Edward Cox, M.D. (Lond.), M.R.C.S. (Eng.), F.R.C.P. (Lond.), F.I.C., 93, St. George's-square, S.W.
1905			Seaton, William Dunham, 40, Argyle-road, Ilford, Essex
1899			Seligman, Richard, Ph.D. (Heidelberg), A.C.G.I., 17, Kensington-palace-gardens, W.
1892	Trans.	C. 1905-	Sell, William James, M.A. (Cantab.), F.R.S., F.I.C., University Chemical Laboratory, Pembroke-street, Cambridge
1875			Sellon, J. Scudamore, 78, Hatton-garden, E.C.
1904	Trans.		Sen, Jatindranâth, M.A. (Calcutta), 71, Cathedral Mission-lane, Calcutta, India
1875	Trans.		‖Senier, Alfred, Prof., M.D. (Mich.), Ph.D. (Berlin), F.I.C., Queen's College, and Gurthard, Galway
1887			Senier, Harold, F.I.C., Hanley House, Ryde, Isle of Wight
1899			Senior, George, B.A. (Lond.), 109, Brynland-avenue, Bishopston, Bristol
1904			Senter, George, Ph.D. (Leipzig), B.Sc. (Lond.), Chemical Laboratory, St. Mary's Hospital Medical School, Paddington, W.
1896			Severn, Walter Dalrymple, Colonial Bacteriological Institute, Grahamstown, Cape Colony, South Africa
1870	Trans.		Seward, Henry, c/o Messrs. J. B. Freeman, Sons, and Co. Wandle Colour Works, Wandsworth, S.W.
1874			‖Sexton, Alexander Humboldt, Prof., F.I.C., F.R.S.E., Metallurgical Department, Andersonian-buildings, 204, George-street, Glasgow
1895			Seyler, Clarence Arthur, B.Sc. (Lond.), F.I.C., The Technical Institute, Nelson-terrace, Swansea

Date of Election.			
1904			Shacklady, Thomas George, Addiscombe-villas, Cliffe-at-Hoo, Rochester, Kent
1880			Shadwell, John Emilius Lancelot, F.I.C., Charlecote, Lansdown, Bath
1874			Sharman, William, 186, Mare-street, Hackney, N.E.
1885			Sharp, James, Shirley Manor, Wyke, near Bradford
1895			Sharrott, Thomas Chilwell, B.A. (Dub.), A.R.C.S., F.I.C., Bovey Tracey School, Devon
1895	Trans.		‖Shaw, George Elliott, B.Sc. (Lond.), F.I.C. 45, Colworth-road, Leytonstone, N.E
1887			Sheard, John T., Birley Mount-villas, Wadsley Bridge, near Sheffield
1905	Trans.		Shedden, Frank, B.Sc. (Lond.), F.I.C., 25, Hareholme-lane, Cloughfold, near Manchester
1899			Shelbourn, Edward Thomas, F.I.C., 40, Craven-street, Strand, W.C.
1899			Shelton, Arthur John, Morriston-place, Clydach, R.S.O., Glamorgan
1904	Proc.		Shelton, Henry Stanley, 4, Larden-road, Acton Vale, W.
1876	Trans.	C. 1893-7	‖Shenstone, William Ashwell, F.R.S., F.I.C., Clifton College, Bristol
1897			Shenton, James Porter, 37, Torbay-road, Chorlton-cum-Hardy near Manchester
1899	Trans.		Shepheard, William Frederick John, 12, Bridge-street-row, Chester
1905			Shepherd, Charles Stuart, Rev., Worth Matravers Vicarage, Wareham, Dorset
1874			‖Shepherd, Harcourt Henry Benjamin, F.I.C., Northcote, Mount Pleasant-lane, Upper Clapton, N.E.
1899			Shepherd, John William, B.Sc. (Lond.), 48, Ovington-street, S.W.
1901	Trans.		Sheppard, Samuel Edward, B.Sc. (Lond.), Ravensmere, Bromley-road, Catford, S.E.
1901			Shepperson, William, The Pryors, East Heath-road, Hampstead, N.W.
1901			Sherratt, Charles Edmund Shaw, 3, Francis-street, Florence, Longton, Staffs.
1901			Sherwood, Edward Charles, Rev., M.A. (Oxon.), St. Peter's College, Westminster, S.W.
1891	Trans.		‖Shields, John, D.Sc. (Edin.), Ph.D. (Strassburg), F.I.C., 4, Stanley-gardens, Willesden Green, N.W.
1896			Shimomura, Kotaro, Prof., Osaka Seimi Works Co., Kawagishicho, Nishiku, Osaka, Japan
1894			Shorthouse, Herbert Stephen, 47, Pershore-road, Birmingham
1904			Shrubsole, Alfred, 91, Holyhead-road, Coventry

Date of Election.		
1886		Shutt, Frank Thomas, M.A. (Toronto), F.I.C., Experimental Farm, Ottawa, Canada
1890		Shuttlewood, Willis Brewin, 78, Whitehall-park, Hornsey-lane, Highgate, N.
1894		Shuttleworth, Edward B., Prof., 220, Sherborne-street, Toronto, Canada
1904		Sian, Raymond Louis, 15, Merridale-lane, Wolverhampton
1903		Sibley, Samuel Edward, 3, Rutland-road, Ilford, Essex
1859		Sibson, Alfred, 23, St. Mary Axe, E.C.
1889		Sibson, Alfred Edward, 19, Carlingford-road, Hampstead, N.W.
1901		Sichel, Gerald Theodore Sylvester, F.R.C.S. (Eng.), L.R.C.P. (Lond.), Eastfield Lodge, Portsmouth-road, Guildford
1903		Siddle, George, Middleton-one-row, R.S.O., Co. Durham
1902	Proc.	‖Sidgwick, Nevil Vincent, M.A. (Oxon.), D.Sc. (Tübingen), Lincoln College, Oxford
1900	Trans.	Silberrad, Oswald, Ph.D. (Würzburg), 51, Shooter's Hill-road, Blackheath, S.E.
1886		Silvester, Harry, Hon. B.Sc. (Birm.), F.I.C., 78, Holy Head-road, Handsworth, Birmingham
1899	Trans.	Simmonds, Charles, B.Sc. (Lond.), "Northcroft," Deronda-road, Herne Hill, S.E.
1889		Simmonds, Henry, Engineer's Office, Gas Works, and Elton View House, Bury, Lancs.
1887		‖Simmons, Leonard Owen, 360, Coldharbour-lane, Brixton, S.W.
1905		Simmons, William Herbert, B.Sc. (Lond.), "Oakleigh," Stoke Newington Common, N.
1895		Simons, Albert Joseph, c/o M. Simons, Esq., 31, Little Britain, E.C.
1896		Simpson, Aitken Migget, Elmcroft, 26, Nelgarde-road, Catford, S.E.
1903		Simpson, Duncan Ivan Rennard, P.O. Box 4225, Johannesburg, Transvaal, South Africa
1897		Simpson, Edward Sydney, B.E. (Sydney), Geological Survey Laboratory, Museum-street, Perth, West Australia
1886		‖Simpson, William Selby, F.I.C., 17, Lake Side-road, Palmer's Green, N.
1903	Proc.	Sindall, Robert Walter, 201, Wellmeadow-road, Catford, S.E.
1889		Singer, Ignatius, c/o Messrs. Whitaker Bros. and Co., Newlay, near Leeds
1902		Sinnatt, Frank Sturdy, Glenside, Church-lane, Moston, Manchester
1896		‖Sircar, Amrita Lal, 51, Sankaritola, Calcutta, India
1902		Skertchly, William Pearson, F.I.C., 11, Billiter-square, E.C.
1888	Trans.	Skinner, Sidney, M.A., South Western Polytechnic, Manresa-road, Chelsea, S.W.

Date of Election.		
1899	Trans.	Skirrow, Frederick William, M.Sc. (Vict.), Ph.D. (Leipzig), 17, Curzon-avenue, Victoria-park, Manchester
1892		Skurray, Thomas, United Breweries, Abingdon, Berks.
1879		Slater, Charles, M.A., M.B. (Cantab.), M.R.C.S. (Eng.), 81, St. Ermin's-mansions, Westminster, S.W.
1880	Trans.	‖Slater, Harold Humboldt, F.I.C., St. Lawrence, Borstal-road, Rochester, Kent
1903	Trans.	Slator, Arthur, Ph.D. (Leipzig), M.Sc. (Birm.), B.Sc. (Lond.), F.I.C., The Priory, Burton-on-Trent
1878		‖Slatter, George William, A.R.C.S.I., F.I.C., 241, Carlton-terrace, Nab Wood, Shipley, Yorks.
1895		Slocum, Frank L., 401, South Linden-avenue, E.E., Pittsburg, Pa., U.S.A.
1875		‖Smetham, Alfred, F.I.C., Analytical Laboratory, Cereal Chambers, 16, Brunswick-street, Liverpool
1898	Trans.	Smiles, Samuel, D.Sc. (Lond.), University College, Gower-street, W.C.
1883		Smith, Adolphe, 12, Crookham-road, Fulham, S.W.
1890	Trans.	‖Smith, Alexander, Prof., Ph.D. (Munich), B.Sc. (Edin.), University of Chicago, Chicago, Ill., U.S.A.
1901		Smith, Andrew Biggam, c/o M. Armstrong, Esq., P.O. Box 90, Queenstown, Cape Colony, South Africa
1888		Smith, Angus, F.I.C., 10, Ardgowan-street, W., Greenock, N.B.
1898		Smith, Benjamin Jordan, 58, King's-road, Reading, and 9, Broxtowe-drive, Mansfield, Notts.
1903		Smith, Charles Joseph, Sunnydale, Walton New-road, Stockton Heath, near Warrington
1904	Trans.	Smith, Clarence, D.Sc. (Lond.), Denmark Lodge, St. James', Hatcham, S.E.
1894	Trans.	Smith, Claude, F.I.C., Barngarth, Cartmel, Carnforth
1884	Trans.	‖Smith, Edgar Francis, Trelawny, 21, Fairfax-road, Bedford Park, W.
1900		Smith, Edward Shrapnell, Cecil Chambers East, Strand, W.C.
1904		Smith, Frank Gurney, 7, Luxemburg-gardens, Brook Green, W.
1892		‖Smith, Fred., Newland Cottage, Garden-street, Rosettenville, Johannesburg, South Africa
1874		Smith, George, Nobel's Explosives Co., Polmont Station, N.B.
1896		Smith, George Egerton Scott, 67, Surrey-street, Sheffield
1892		‖Smith, George Percy Darnell-, B.Sc. (Lond.), F.I.C., The Merchant Venturers' Technical College, Bristol
1905		Smith, Gerald Oscar Morgan-, Snettisham School, King's Lynn, Norfolk
1901		Smith, Henry Ewing, 22, City-road, E.C.
1896	Trans.	Smith, Henry George, The Technological Museum, Sydney, N.S.W.

Date of Election.			
1904			Smith, Henry Heron, F.I.C., 76, Plumstead-common-road, Plumstead, Kent
1878			Smith, Henry Russell, F.I.C., 1, Aubert-park, Highbury, N.
1900			‖Smith, Herbert Procter, Shotton-lane, Shotton, Flints.
1890			Smith, Harry Wood, B.Sc., c/o Messrs. John Batt and Co., Ltd., 39, Old Broad-street, E.C.
1901			Smith, James, 30, Milner-road, Aigburth, Liverpool
1903			Smith, James Cruickshank, B.Sc., 5, The Elms, London-road, Wembley, R.S.O., Middlesex
1879			Smith, J. W., 7, Brookfield-street, Roslindale, Boston, Mass., U.S.A.
1903			Smith, Leonard, Hillside, Park-hill-road, Croydon
1901	Trans.		Smith, Norman, B.Sc. (Vict.), The University, Manchester
1902			Smith, Robert Ely Blake, B.Sc. (Lond.), A.I.C., 31, St. John's-road, Putney, S.W.
1897			Smith, Robert Francis Wood, 89, Bartholomew-close, E.C.
1891			Smith, R. Greig, D.Sc. (Edin.), Linnean Society's House, Elizabeth Bay, Sydney, N.S.W.
1888			Smith, Samuel, Hillsboro', Goddard-avenue, Old Swindon
1904			Smith, Samuel John, 41, Grafton-street, Dublin
1898			Smith, Thomas De, M.A. (Cantab.), Moor Platt, Caton, near Lancaster
1876			|Smith, William Alexander, M.A., M.B. (Oxon.), M.R.C.S. (Eng.), Newport, Essex
1866	Trans.		Smith, Watson, F.I.C., 34, Upper-park-road, Haverstock Hill, N.W.
1904			Smith, William Veysey, B.A. (Oxon.), 81, Surrey Street, Norwich
1883	Trans.	C. 1896-1900 V.P. 1905-	‖Smithells, Arthur, Prof., B.Sc. (Lond.), F.R.S., F.I.C., The University, Leeds
1873			‖Smyth, John, M.A. (Dub.), M.I.C.E., Milltown, Banbridge, Ireland
1902			Smythe, John Seabury, B.Sc. (Vict.), Ph.D. (Würzburg), "Rantallard," Lance-lane, Wavertree, Liverpool
1887	Trans.		‖Snape, Henry Lloyd, Prof., D.Sc. (Lond.), Ph.D. (Göttingen), F.I.C., Balholm, Lathom-road, Southport
1899	Trans.		Soddy, Frederick, M.A. (Oxon.), Chemical Department, The University, Glasgow
1896	Trans.		Sodeau, William Horace, D.Sc. (Lond.), F.I.C., 19, East-parade, Newcastle-on-Tyne
1887			Sohn, Charles Emile, F.I.C., 2, Harpur-street, Bedford-row, W.C.
1891			Solomon, Frank Oakley, Dauntsey's Agricultural School, West Lavington, Devizes, Wilts.
1874	Trans.		Sonstadt, Edward, Church Field, Cheshunt, Herts.

Date of Election.			
1893			Sorrell, Henry Thomas, The Eagle Brewery, Wellclose-square, E.
1875			Southall, Alfred, Garrick House, Richmond Hill, Edgbaston
1897	Proc.		Southerden, Frank, B.Sc. (Lond.), F.I.C., Royal Albert Memorial College, Exeter
1897			Southern, Thomas, jun., Wheat Hill Chemical Works, near Broughton Bridge, Manchester
1902			Southworth, William, Agricultural and Horticultural College, Uckfield, Sussex
1883			Soward, Alfred Walter, 28, Therapia-road, Honor Oak, S.E.
1892			Spackman, Charles, Rosehaugh, Clitheroe, Lancs.
1905			Speight, William Ewart, Corporation Sewage Works, Deighton, Huddersfield
1901			Spence, John Davidson, 2, Hawk Hill-place, Perth-road, Dundee
1883			‖Spencer, Ernest Samuel, Arborfield, Wimbledon Park, S.W.
1886			Spencer, Richard, 242, Dalton-road, Barrow-in-Furness
1887			‖Spencer, Walter Shelley, Lyndene, Darley-grove, Farnworth, near Bolton
1894			Spenzer, John George, Prof., M.D., Ph.D. (Strassburg), Ohio Wesleyan University, 261, Amesbury-avenue, Cleveland, Ohio, U.S.A.
1905			Spielmann, Percy Edwin, A.R.C.S., A.I.C., 21, Cadogan-gardens, S.W.
1859	Trans.		‖Spiller, John, F.I.C., 2, St. Mary's-road, Canonbury, N.
1863			‖Spiller, William, F.I.C., Atlas Dye Works, Hackney Wick, E.
1885			‖Spottiswoode, William Hugh, Balliol College, Oxford; and 6, Middle New-street, E.C.
1864	Trans.	C. 1872-6	Sprengel, Hermann Johann Philipp, Ph.D. (Heidelberg), F.R.S., Royal Prussian Professor (titular), Savile Club, 107, Piccadilly, W.
1882			‖Squire, Peter Wyatt, 413, Oxford-street, W.
1858	Trans.		Squire, W. Stevens, Ph.D., Clarendon House, St. John's Wood-park, N.W.
1892			Squires, Alfred James, "Greenbank," Coroner's-lane, Farnworth, Widnes, Lancs.
1877			Stacey, Henry George, 300, High Holborn, W.C.
1899			Stainer, John Ward, 103, Cheriton-road, Folkestone
1897			Stainer, William James, B.A., 5, Girton-villas, Osmond-road, Hove, Sussex
1879	Trans.		‖Stallard, George, M.A. (Oxon.), Horton-crescent, Rugby
1904			Stanger, Reginald Harry Hursthouse, Chemical Laboratory and Testing Works, 2, Broadway, Westminster, S.W.
1902			Stanger, William C. S., Ambleside, Corder-road, Ipswich
1904			Stanley, Harry, B.Sc. (Lond.), The Merchant Venturers' Technical College, Bristol

Date of Election.		
1887		‖Stansell, Lionel William, F.I.C., 7, Albion-place, Maidstone, Kent
1895		‖Stansfield, Alfred, D.Sc. (Lond.), McGill University, Montreal, Canada
1903		Stansfield, Edgar, B.Sc. (Vict.), The Technical College, Sunderland
1899		Stansfield, Samuel, B.Sc. (Vict.), 2, Park-road, Batley, Yorks.
1900	Trans.	Stapleton, Henry Ernest, Prof., B.A. (Oxon.), B.Sc., Presidency College, Calcutta, India
1870		Starey, Arthur John, 39, Woodland-gardens, Highgate, N.
1870	Trans.	‖Stark, James Fleming, Rosedale, Bromborough, Cheshire
1902		Stead, Francis Bernard, Clifton College, Bristol
1896		Stead, John Christopher, 1, Finsbury-circus, E.C.
1882	Trans.	Stead, John Edward, F.R.S., F.I.C., 11, Queen's-terrace, Middlesbrough
1897		Steel, F. W., c/o Messrs. Cuming Smith and Co., Yarraville, Melbourne, Victoria
1885		Steel, Robert Elliot, County School, Northampton
1890		Steel, Thomas, c/o Colonial Sugar Refining Co., O'Connell-street, Sydney, N.S.W.
1900	Trans.	Steele, Bertram Dillon, D.Sc. (Melbourne), Heriot-Watt College, Edinburgh
1905		Steger, James, B.Sc. (Lond.), 111, Chesterfield-road, Bristol
1898		Steinhart, Oscar Julian, Ph.D. (Erlangen), c/o Steinhart, Vogel & Cloud, Highfield Works, Feltham, R.S.O., Middlesex
1901		Stell, Samuel Fenton, 25, Henry-street, Keighley
1892	Trans.	‖Stenhouse, James, View-park-gardens, Bonnyrigg, Midlothian, N.B.
1884		Stenhouse, Thomas, F.I.C., Townhead, Rochdale
1905		Stennitt, Sydney Dockeray, M.Sc. (Vict.), 16, Richmond-terrace, Whitchurch, Salop
1895	Trans.	Stephens, Frank R., c/o Messrs. Idris, Pratt-street, Camden Town, N.W.
1880		‖Stephens, Henry Charles, M.P., Cholderton, Salisbury
1897		Stephens, Michael Edmund, 57, Aldersgate-street, E.C.
1895		Stephenson, Herbert Frederick, A.R.C.S., Fairhaven, Lucien-road, Tooting Common, S.W.
1902		Stephenson, Robert, jun., M.A. (Cantab.), Burwell, Cambridge
1891	Trans.	Stephenson, Thomas, 137, George-street, Edinburgh
1888	Trans.	Stern, Arthur Landauer, D.Sc. (Lond.), F.I.C., Southbank, Stapenhill, Burton-on-Trent
1896		Stenart, Douglas Stuart Spens, B.Sc. (Vict.), The Royal Societies' Club, St. James's-street, S.W.
1903	Trans.	Steven, Alec Bowring, B.Sc. (Lond.), The University, Leeds
1905		Stevens, Edmund Henry, Haw House, Rothbury, Northumberland

Date of Election.			
1905			Stevens, Harold Blythen, 225, Oxford-street, W.
1897	Trans.		Stevens, Henry Potter, M.A. (Oxon.), Ph.D. (Heidelberg), F.I.C., 15, Borough, London Bridge, S.E.
1903			Stevens, Montague White, A.R.C.S., A.I.C., H.M. Patent Office, 25, Southampton-buildings, W.C.
1899			Stevenson, Arnold, B.A. (Cantab.), 4, Porchester-gardens, W.
1903	Trans.		Stevenson, Henry Edward, 155, Coventry-road, Ilford, Essex
1904			Stevenson, Henry Ernest, "Avondale," Ditton Hill, Surrey
1864		C. 1872-5, 86-8, 94-7 V.P. 1900-03.	Stevenson, Sir Thomas, M.D. (Lond.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), F.I.C., Guy's Hospital, S.E.
1879			Stevenson, William, 95A, Southwark-street, S.E.
1904	Trans.		Stewart, Alfred Walter, B.Sc. (Glas.), 18, Annfield-terrace, Partickhill, Glasgow
1902			Stewart, Hector, General Manager, Knight's Petersburg Gold Mines, Ltd., Petersburg, Transvaal, South Africa
1872			‖Stewart, Walter, 3, Queensferry-gardens, Edinburgh
1866			Stock, William Frederick Keating, F.I.C., 5, Dixon-terrace, Darlington
1874			‖Stocks, Frederic, Snead's Green House, Elmley Lovett, Droitwich, Worcs.
1887			Stocks, Herbert Birtwhistle, F.I.C., Lynwood, Neston, Cheshire
1894	Trans.		Stoddart, Frederick Wallis, F.I.C., Grafton Lodge, Sneyd Park, Bristol
1879	Proc.		‖Stokes, Alfred Walter, F.I.C., Vestry Hall, Paddington, W.
1873			‖Stone, Edward Daniel, Ackersley, Cheadle Hulme, near Stockport, Cheshire
1895			Stone, George, Esk Brewery, Launceston, Tasmania
1875			‖Stone, John Frederic Matthias Harris, M.A. (Cantab.), F.L.S., Barrister-at-Law, 4, Temple, E.C.
1879			‖Stone, William, M.A. (Cantab.), F.L.S., F.Z.S., Oxford and Cambridge, Garrick, Bath, Union and Reform Clubs, and I, 5 and 6, The Albany, Piccadilly, W.
1891			‖Storey, James Ashburner, B.Sc. (Vict.), Igalkanda Estate, Elpitiya, Ceylon; and Underfell, Lancaster
1900			Storr, Bertram Vincent, B.Sc. (Vict.), 61, Balfour-road, Ilford, Essex
1887			‖Strangman, James Pim, 38, Rue Desbordes-Valmore, Paris-Passy
1904	Trans.		Streatfeild, Frederick Henry, 9, Crescent-road, South Tottenham, N.
1900			Strong, Archie Hugh, 63, Herne-hill-road, Camberwell, S.E.
1904	Trans.		‖Struthers, Robert de Jersey Fleming-, B.A. (Oxon.), Exeter College, Oxford
1885	Trans.		‖Stuart, Charles Maddock, M.A. (Cantab.), F.I.C., St. Dunstan's College, Catford, S.E.

Date of Election.		
1897	Trans.	Stubbs, George, Arnside, Hertford-road, East Finchley, N.
1893		Styles, Robert Curling, A.R.S.M., F.I.C., Knockhall, Greenhithe, Kent
1890	Trans.	‖Sudborough, John Joseph, Prof., D.Sc. (Lond.), Ph.D. (Heidelberg), F.I.C., University College of Wales, Aberystwyth
1878	Trans.	‖Suguira, Shigetake, c/o Tokio Chemical Society, 50, Kasugacho, Koishikawa, Tokio, Japan
1897		Sumner, Leonard, B.Sc. (Vict.), Butt Hill, Prestwich, near Manchester
1905		Sutcliffe, Thomas, Ivy House, Greetland, Yorks
1887		‖Sutherland, David Alexander, F.I.C., 13, Victoria-street, Westminster, S.W.
1860		Sutton, Francis, F.I.C., Laboratory, Bank Plain, Norwich
1886		‖Sutton, Francis Napier, F.I.C., 6, Grosvenor-gardens, Willesden Green, N.W.
1902		Swain, James, 17, Winsham-street, West-side, Clapham Common, S.W.
1875		Swan, Sir Joseph Wilson, Hon. M.A. (Dun.), Hon. D.Sc., F.R.S., 58, Holland-park, W.
1905		Swann, Robert Reed, B.Sc. (Dunelm), The Agricultural College, Aspatria, Cumberland
1894		‖Swinburne, James, 82, Victoria-street, S.W.
1891		Sykes, Matthew Carrington, M.D. (Dun.), F.R.C.S. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), D.P.H. (Lond.), Sykeshurst, Barnsley, Yorks.
1880		Symons, Brenton, Burwood, Warminster-road, South Norwood, S.E.
1874	Trans.	‖Symons, William Henry, M.D. (Brussels), D.P.H. (Oxon.), M.R.C.S. (Eng.), F.I.C., Health Office, Guildhall, Bath
1899	Trans.	Szarvasy, Charles Emerique, Ph.D., Muegyetem VIII, Budapest, Hungary
1881	Trans.	‖Takamatsu, Toyokichi, Prof., Engineering College, Imperial University, Tokio, Japan
1887	Trans.	‖Takamine, Jokichi, 613, West 142nd-street, New York, U.S.A.
1901		Tankard, Arnold Rowsby, 11, All Saints'-road, King's Heath, Birmingham
1894		Tanner, Alfred E., Westminster Hospital, S.W.
1901		Tatam, George William Gerald, 1, Hagley-grove, Hagley-road, Birmingham
1890		Tate, Francis Henry, 9, Hackins Hey, Liverpool
1881	Trans.	Tate, George, Ph.D. (Würzburg), F.I.C., Windsor Buildings, George-street, Liverpool.

Date of Election.		
1884		‖Tate, Walter, The Woodlands, Twerton-on-Avon, Bath
1890		Tate, William, Prof., Hillside, Somers-park-avenue, Malvern Link
1867		Tatlock, Robert Rattray, F.I.C., 11, Bellshaugh-road, Kelvinside West, Glasgow
1894		Taylor, Albert, 16, Wellington-grove, Stockport
1882		Taylor, Gotfred Midgley, 27, Great George-street, Westminster, S.W.
1894		Taylor, Herbert John, 52, Alexandra-crescent, Dewsbury
1880		‖Taylor, James, B.Sc., Nymagee, New South Wales
1891		Taylor, John, 15, Lucius-street, Torquay
1888		Taylor, John George, 3, Outram-street, Stockton-on-Tees
1905		Taylor, John William, University College, Reading
1874	Trans.	‖Taylor, Robert Llewellyn, F.I.C., 37, Mayfield-road, Whalley Range, Manchester
1902		Taylor, Thomas, A.I.C., 12, Ancaster-drive, Great Western-road, Glasgow
1901		Taylor, William Henry, B.Sc. (Lond.), F.I.C., 4A, Durlston-road, Northwold-road, Upper Clapton, N.E.
1878		‖Tcherniac, Joseph, Ph.D., c/o South Metropolitan Gas Co., 709, Old Kent-road, S.E.
1879	Trans.	‖Teed, Frank Litherland, D.Sc. (Lond.), F.I.C., 9, Mincing-lane, E.C.
1901		Templeman, William Henry, 67, Park-street, Spring Bank, Hull
1894		‖Terry, Edwin, 374, Brixton-road, S.W.
1881		Tervet, Robert, 54, Penshurst-road, South Hackney, E.
1893		Thackrah, James Robert, M.A. (Oxon.), Ph.D. (Leipzig), Technical Schools, Tavistock-road, Plymouth
1895		Theodosius, Alfred Fletcher, M.A. (Oxon.), University College, Oxford
1905		Thibault, Paul John, Howell, New South Wales
1899		Thiersch, Harry Alexander, 8, Clifton-gardens, Maida Vale, W.
1901		Thomas, Albert Edward, B.Sc. (Lond.), F.I.C., Science and Technical Schools, Barrington-street, Tiverton, Devon
1871		‖Thomas, Charles, J.P., Stoke Bishop, near Bristol
1905		Thomas, George Devenish, B.Sc. (Lond.), 18, Randolph-gardens, Dover
1874		Thomas, Harry Edgecumbe, Rockleaze Point, Clifton, Bristol
1875	Trans.	‖Thomas, Joseph William, F.I.C., Overdale, 6, Kingswood-road, Shortlands, Kent
1877		‖Thompson, Beeby, 67, Victoria-road, Northampton
1904		Thompson, Charles Herbert, Hillcroft, Amblecote, Stourbridge
1886	Trans.	‖Thompson, Claude Metford, Prof., M.A. (Oxon.), D.Sc. (Lond.), University College, and 38, Park-place, Cardiff

Date of Election.			
1894			Thompson, Edward Cumming, 40, Glenluce-road, Westcombe Park, S.E.
1893			Thompson, Frank Ernest, 51, Lichfield-road, Walsall
1893			Thompson, George Roos, The Laboratory, 69, Dock-street, Newport, Mon.
1897			Thompson, Harry, Chemical Laboratory, 5, Bishop-lane, Hull
1904			Thompson, Hubert, B.Sc. (Vict.), Agricultural College, Holmes Chapel, Cheshire
1886			Thompson, William Phillips, 95, Shrewsbury-road, Claughton, Birkenhead
1903			Thomson, George Malcolm, Newington, Dunedin, New Zealand
1872	Trans.	C. 1880-3, 1904- S 1883-98 V.P. 1898-1901	‖Thomson, John Millar, Prof., Hon. LL.D. (Glas.), F.R.S., F.I.C., King's College, W.C., and 9, Campden Hill-gardens, W.
1899			Thomson, Robert Tatlock, F.I.C., 156, Bath-street, Glasgow
1872			Thomson, William, F.I.C., Royal Institution Laboratory, Manchester
1895			Thomson, William Thomas, Oxford-villas, Waltham Abbey
1891			Thonger, Cecil George Freer, The Grange, Hollesley, Suffolk
1882	Trans.		Thorne, Leonard Temple, Ph.D. (Würzburg), F.I.C., 2, Denbigh-gardens, Richmond, Surrey
1891			Thorp, Walter, B.Sc. (Lond.), F.I.C., Analytical Laboratory, Limerick
1893	Trans.		Thorpe, Jocelyn Field, Ph.D., The University, Manchester
1871	Trans.	C.1879-83 V.P. 84-7 T. 89-99 P. 1899-1901	†‖Thorpe, Thomas Edward, Prof., C.B., D.Sc. (Vict.), Sc.D. (Dub.), Ph.D. (Heidelberg), LL.D. (Glas.), F.R.S., Government Laboratory, Clement's Inn-passage, W.C.
1899			Threlfall, Richard, Prof., M.A. (Cantab.), F.R.S., A.M.I.C.E., 30, George-road, Edgbaston, Birmingham
1880			Thwaite, Benjamin Howarth, 29, Great George-street, Westminster, S.W.
1895			Tibbals, W. I., 187, Canton-avenue, Detroit, Mich., U.S.A.
1897	Trans.		Tickle, Thomas, B.Sc. (Lond.), F.I.C., 83, Queen-street, Exeter
1902			Tidy, Henry Letheby, B.A. (Oxon.), 15, Adam-street, Portman-square, W.
1903			Tighe, Arthur, Ranelagh, Darling Point, Sydney, N.S.W.
1903			Tilburn, Charles, 31, Hardy-street, South Yarra, Melbourne, Australia
1865	Trans.	C.1878-81 V.P. 85-8 91-4, 96-9 T. 1899-03 P.1903-05	‖Tilden, William Augustus, Prof., D.Sc. (Lond.), Hon. Sc.D. (Dub.), Hon. D.Sc. (Vict.), F.R.S., F.I.C., Royal College of Science, South Kensington, S.W.; and The Oaks, Northwood, Middlesex

† Longstaff Medallist, 1881.

Date of Election.		
1900		Tilley, James Walter, 95a, Southwark-street, S.E.
1902		Tindall, Arthur Lea Butler, M.A. (Cantab.), Dagnall, Bakewell
1904		Tingle, Alfred, B.Sc. (Lond.), Ph.D. (Penn.), Imperial Provincial College of Shantung, Chinanfu, Shantung, China
1889		‖Tingle, John Bishop, Ph.D., Johns Hopkins University, Baltimore, U.S.A.
1898		Tisdale, Charles William Walker, University College, Reading
1905		Titherley, Arthur Walsh, D.Sc. (Vict.), D.Sc. (L'pool.), Ph.D. (Heidelberg), Southcot, Moreton, near Birkenhead
1891		Tocher, James Fowler, F.I.C., 1, Chapel-street, Peterhead
1903		Tolson, Stanley, Sinclair, Gravelly-hill, Birmingham
1900		Tomlins, George Edward, "Fernleigh," Church-road, Leatherhead, Surrey
1884	Trans.	‖Tompson, Frederick William, The Bower, Limpsfield, Surrey
1877		‖Toms, Frederick Woodland, F.I.C., Official Analyst, Jersey
1904		Tong, Walter, "Holmdene," Pole-lane, Failsworth, Manchester
1905		Tonkin, Arnold Bertram, Government Laboratory, Durban, Natal, South Africa
1855	Trans.	‖Tookey, Charles, F.I.C., Museum of Practical Geology, Jermyn-street, S.W., and The Portland Hotel, Great Portland-street, W.
1893		‖Towers, John William, Victoria-road, Widnes
1888		Townsend, Charles Francis, 1, Morgan-road, Bromley, Kent
1903		Toyne, Francis Digby, B.A. (Cantab.), 95, Goldsmith-street, Nottingham
1901		Tozer, Herbert Ackerman, B.A. (Lond.), 113, Stepney Green, E.
1887		‖Traphagen, Frank W., Prof., Ph.D., Colorado School of Mines, Golden, Colorado, U.S.A.
1900		Traquair, John, Glenfield Starch Works, Paisley, N.B.
1892	Trans.	Travers, Morris William, Prof., D.Sc. (Lond.), F.R.S., University College, Bristol
1895		Trehärne, Frederick Gwilym, Wrangbrook, Llanishen, near Cardiff
1888		‖Trewby, Herbert, 62, St. John-street, E.C.
1881		‖Trigger, Oliver, F.I.C., Chemical Dept., Royal Arsenal, Woolwich, S.E.
1902		Trimen, Stephen Herbert, Survey Dept., Public Works Ministry, Cairo, Egypt
1897		Tripp, Edward Howard, Ph.D. (Marburg), The Modern School, Bedford
1905		Troye, Gustave Arthur, P.O. Box 2706, Transvaal, South Africa
1905		Tuck, William Bradshaw, University College, Gower-street, W.C.
1898	Trans.	Tucker, Samuel Auchmuty, Ph.D., Columbia University, New York, U.S.A.
1889		Tucker, Willis G., M.D., Ph.D., Medical College, Albany, New York, U.S.A.

Date of Election.		
1896		Tuckett, James Edwin Shum, M.A. (Cantab.), Marlborough College, Wilts.
1892		Tuer, Arthur Holt, Thornhill, Wigan, Lancs.
1902		Tunnicliffe, William Wright, B.Sc., Sunnyside, Newhall, Burton-on-Trent
1897	Trans.	Turnbull, Andrew, Ph.D. (Heidelberg), 3, Lord-street, Liverpool
1903		Turner, Arnold, 84, Molesworth-street, Rochdale
1886		Turner, Arthur, The Limes, Aylesbury
1896		Turner, Benjamin Bernard, B.Sc. (Lond.), Ph.D. (Göttingen), Connecticut Agricultural College, Storrs, Conn., U.S.A.
1897		Turner, Basil William, Wood's-chambers, 5, Moore-street, Sydney, N.S.W.
1888	Trans.	Turner, Charles, 225A, Oxford-street, Manchester
1897		Turner, John Scriven, 20, Bury-street, Bloomsbury, W.C.
1902		Turner, Lyon Viccars, Crescent Lodge, St. John's, S.E.
1883	Trans.	‖Turner, Thomas, Prof., M.Sc. (Vict.), A.R.S.M., F.I.C., The University, Birmingham
1904	Trans.	Turner, William Ernest Stephen, M.Sc. (Birm.), B.Sc. (Lond.), University College, Sheffield
1889	Trans.	Turpin, George Sherbrooke, M.A. (Cantab.), D.Sc. (Lond.), High School, Nottingham
1871		‖Tustin, John Robert, F.R.G.S., Albion House, The Marina, Deal
1888	Trans.	Tutton, Alfred Edwin Howard, D.Sc. (Oxon.), F.R.S., 41, Ladbroke-square, W.
1892		Tweedie, Thomas Shortridge, Trensano, Annan, N.B.
1904	Trans.	Twiss, Douglas Frank, M.Sc. (Birm.), The Municipal Technical School, Suffolk-street, Birmingham
1899	Trans.	Tyler, Ernest Albert, B.A., 33, The Promenade, Mount Pleasant
1876		Typke, Paul George William, F.I.C., Lawn House, New Malden, Surrey
1876		Tyrer, Thomas, F.I.C., Stirling Chemical Works, Abbey-lane, Stratford, E.
1903		Tyrrell, Dennis, 182, King-street, Norwich
1885		Tyson, Thomas B., 4, Fernhill-terrace, New Quay, Cornwall
1876		‖Udall, Thomas Bertram, Newcastle-under-Lyme, Staffs.
1865		Umney, Charles, F.I.C., 50, Southwark-street, S.E.
1893	Trans.	Umney, John Charles, 50, Southwark-street, S.E.
1889		‖Underhill, Thomas John, "Stanley," Quernmore-road, Bromley, Kent.
1904		Underhill, William Wood, 10, Hartham-road, Holloway, N.

Date of Election.			
1897			‖Unwalla, Rustomji Navroji, Medical Dept., Bhaunagar, Kathiawâr, India
1882			‖Vacher, Francis.
1890			Valentin, Basil William, Messrs. Buckley Bros., Brewery, Llanelly, S. Wales
1903			Van Laer, Norbert, c/o Messrs. Truman, Hanbury, Buxton and Co., Ltd., Burton-on-Trent
1901			Varley, Harold Foy Fleetwood, 110, Woodlands-park-road, Harringay, N.
1883			Vasey, Samuel Archibald, F.I.C., Beechcroft, Burnt Ash-lane, Bromley, Kent
1882			Vasey, Thomas E., B.Sc. (Lond.), c/o Chancery-lane Safe Deposit Co., Chancery-lane, W.C.
1894			Vaux, Cuthbert, 11, Thornhill-park, Sunderland
1879	Trans.		Veley, Victor Herbert, M.A., D.Sc., (Oxon.), F.R.S., 20, Bradmore-road, Oxford
1891			Velling, Frederick William de, B.A., High Grade Board School, The Boulevard, Hull
1881			Venable, Frank P., Ph.D., Chapel Hill, North Carolina, U.S.A.
1887			‖Vergara, Vargas José Maria, Apartado No. 237, Bogotá, Colombia
1901			Verteuil, Joseph de, Clarence-street, Port of Spain, Trinidad, B.W.I.
1897			Viccajee, Framjee Khurshedjee, H.H. The Nizam's Mint, Hyderabad, Deccan, India
1897			Vinter, Percy John, M.A. (Cantab.), 33, Lynton-road, Acton, W.
1884			‖Voelcker, Edward William, A.R.S.M., F.I.C., 22, Tudor-street, Blackfriars, E.C.
1884		C.1891-5 1902-04	‖Voelcker, John Augustus, Hon. M.A. (Cantab.), Ph.D. (Giessen), B.A., B.Sc. (Lond.), F.I.C., 20, Upper Phillimore-gardens, Kensington, W.
1889			‖Voss, Walter Arthur, Eastwood-road, Rayleigh, Essex
1885			Vulté, Hermann T., Ph.D., Columbia University, New York City, U.S.A.
1901			‖Wade, Frank, A.R.C.S., F.I.C., 76, Beach Farm-road, Southsea, and Laboratory, H.M. Dockyard, Portsmouth
1890	Trans.	C. 1905-	‖Wade, John, D.Sc. (Lond.), F.I.C., 7, Trinity-square, Southwark, S.E., and Guy's Hospital, London Bridge, S.E.

Date of Election.			
1903	Trans.		Wadmore, John Mello, M.A. (Oxon.), Aldenham School, near Elstree, Herts.
1901			Wager, Morton, B.Sc. (Lond.), 63, Dark-lane, Batley, Yorks.
1894			‖Wagner, William G., Glyndhurst, Ealing Common, W.
1902			Wain, William Charles, Explosives Department, Sydney, N.S.W.
1884			Wainwright, J. Howard, Ph.D., Room 1210, 60, Wall-street, New York City, U.S.A.
1893			Wait, Charles E., Prof., University of Tennessee, Knoxville, U.S.A.
1888			‖Wait, Frank Goodell, Geological Survey Department, Ottawa, Canada
1899			Walden, Allan Frederick, M.A. (Oxon.), 37, High-street, and New College, Oxford
1897			Walford, Samuel Matthew, Wyncote, Hatherlow, Stockport
1868			‖Walker, Alexander, Major-General, C.S.I., R.A., 5, Montague-place, Russell-square, W.C.
1881			‖Walker, Archibald, M.A. (Oxon.), F.I.C., 7, Crown-terrace, Dowanhill, Glasgow
1898			Walker, Andrew Jamieson, Ph.D. (Heidelberg), B.A. (Dub.), Municipal Technical College, Derby
1900			Walker, Augustus John, 1, Linton-road, Hastings
1899			Walker, Charles, c/o T. B. Walker, Esq., School of Mines, Charters Towers, Queensland, Australia
1894	Trans.		Walker, Charles Henry Hirst, M.A. (Oxon.), Secondary School, Oldbury, Birmingham
1889			Walker, Daniel, School of Mines, Ballarat, Victoria, Australia
1890	Trans.	C. 1899-04.	‖Walker, James, Prof., D.Sc. (Edin.), Ph.D. (Leipzig), F.R.S., University College, and 8, Windsor-terrace, Dundee
1890			Walker, James Samuel Hourston, M.B., C.M. (Edin.), Clinical Research Association, 1, Southwark-street, S.E.
1897	Trans.		Walker, James Wallace, Prof., M.A., Ph.D., McGill University, Montreal, Canada
1865	Trans.		‖Walker, John Francis, M.A. (Cantab.), F.I.C., 45, Bootham, York; and Sidney Sussex College, Cambridge
1888			Walker, J. T. Ainslie, 6, Selwyn-road, Upton Manor, E.
1881			Walker, Robert William, Gossefield, Moss-lane, Ashton-on-Mersey, Manchester
1898			Walker, Samuel, M.A., D.Sc. (Edin.), 126, Gilmore-place, Edinburgh
1879			‖Walker, Thomas Hatfield, Conyer's House, Newcastle-on-Tyne
1904			Walker-Pole, Miles, 71, De Korte-street, Braamfontein, Johannesburg, South Africa
1905			Wall, Francis Henry, 7, King's-parade, Church End, Finchley, N.

Date of Election.			
1901			Wallace, Herbert George, Blenheim Club, 12, St. James's-square, S.W.
1884			‖Wallace, Robert, Prof., The University, Edinburgh
1878			‖Waller, Elwyn, A.M., Ph.D., 7, Franklin-place, Morristown, N.J., U.S.A.
1904			Walling, Léon Edward, 43, Union-road, Rotherhithe, S.E.
1902			‖Wallis, Thomas Edward, B.Sc. (Lond.), A.I.C., 37, Upper Grosvenor-road, and The Technical Institute, Tunbridge Wells, Kent
1883			‖Walmsley, Robert Mullineux, D.Sc. (Lond.), Northampton Institute, St. John Street-road, Clerkenwell, E.C., and 23, Hilldrop-road, Camden-road, N.
1888			Walrond, Edward Dalrymple, B.A. (Cantab.), North Eastern Counties School, Barnard Castle, Durham
1903			Walsh, Thomas Crosbie, Casilla 12, Antofagasta, Chile, South America
1899			Walton, Robert Hawks, Flinders, Martin's-avenue, Bondi, Sydney, N.S.W.
1884			‖Walton, Thomas Utrick, B.Sc. (Glas.), F.I.C., Colonial Sugar Refining Co., Sydney, N.S.W.
1905			Want, William Phillip, 11, Pearfield-road, Forest Hill, S.E.
1864			Ward, George, F.I.C., Buckingham-terrace, Headingley, Leeds
1895			Ward, George John, Hallam Fields, Ilkeston
1891			Ward, Thomas Armistead, 15, Exchange-street, Blackburn
1875			Wardle, Sir Thomas, F.G.S., Leek, Staffs.
1863	Trans.	C.1874-6 78-82. V.P. 89-93.	‖Warington, Robert, Prof., M.A. (Oxon.), F.R.S., High Bank, Harpenden, Herts.
1871			Warner, George Joseph, Halton Villa, Widnes
1888			Warrick, Frederic Walmsley, 6, Nile-street, City-road, N.
1895			Warrington, Thomas Cotterill, M.A. (Oxon.), 29, Stockwell-street, Leek, Staffs.
1882			Waterfall, Charles James, F.I.C., 4, Queen-square, Bristol
1901			‖Waterhouse, James, Major-General, I.S.C., Hurstmead, High-street, Eltham, Kent
1894			Waterhouse, Robert, 8, Severn-road, Sheffield
1893			Watson, Alexander Forbes, B.Sc. (Edin.), F.I.C., Laboratory, Watling-street, Dublin
1885			Watson, Charles, c/o Messrs. Josiah Hardman, Ltd., Aston Church-road, Birmingham
1905	Trans.		Watson, Edwin Roy, B.A. (Cantab.), B.Sc. (Lond.), Civil Engineering College, Sibpur, Calcutta, India
1887			‖Watson, Frederick Percy, 6 and 7, Bailgate, Lincoln
1899			Watson, Fred Sheasby, B.Sc. (Vict.), Sandgate, Villiers-road, Woodthorpe, Nottingham

Date of Election.		
1904		Watson, Herbert Wood, B.Sc. (Vict.), 111, Brudenell-road, Hyde-park, Leeds
1883		‖Watson, Thomas Donald, 16, St. Mary's-road, Bayswater, W.
1876	Trans.	‖Watson, William Henry, J.P., Croft Hall, Seascale, Cumberland
1877		Watt, Alexander, c/o Messrs. Macfie and Sons, 34, Moorfields, Liverpool
1904		Watt, Francis Langston, A.R.C.S., A.I.C., Russenden, Stanley-street, Epping, near Sydney, N.S.W.
1883	Trans.	Watts, Hon. Francis, C.M.G., Hon. D.Sc. (Birm.), F.I.C., Government Laboratory for the Leeward Islands, Antigua, West Indies
1872	Trans.	‖Watts, John, M.A. (Oxon.), D.Sc. (Lond.), F.I.C., Merton College, Oxford
1878	Trans.	Watts, John I., Beechfield, Hartford, Cheshire
1888		Way, Edward John, F.I.C., New Kleinfontein Co., Ltd., Benoni, Transvaal, South Africa
1901		Wayland, William A., 12, Albert-road, St. John's, S.E.
1902		Webb, Arthur James, M.A. (Oxon.), B.Sc., 21, Hammelton-road, Bromley, Kent
1883	Trans.	Webster, Charles Stuart Stanford, F.I.C., Malvern House, Redland, Bristol
1866		Webster, G. W., 1, Grange-road, West Kirby, Birkenhead
1877		Webster, William, 50, The Park, Blackheath, S.E.
1904		Weeks, Henry Bridges, F.I.C., The Retreat, Infield-park, Barrow-in-Furness
1904		Weinberg, John, Rosa Sugar Works and Distillery, Rosa United Provinces, India
1905		Weiskopf, Eric H., Dynamite Factory, Modderfontein, Transvaal, South Africa
1904		Weiss, Carl Friederich Richard, M.A., Ph.D. (Bâle), 27A, St. Mary-at-hill, E.C.
1898		Weissmüller, Edward Charles, 8, Stanley Villas, Greenway-road, Runcorn
1901		Welch, George Edward, B.Sc. (Lond.), Grammar School, Wakefield
1888		Welch, John Cuthbert, General Superintendent, Alaska Copper Co., Coppermount, Alaska, U.S.A.
1893		Welchman, Frank Ernest, 16, Carlton-road, Putney Hill, S.W.
1891		Wellington, Stephen Newcombe, c/o The Gas and Water Co., Ltd., Colombo, Ceylon
1884	Trans.	Wells, James S. C., Ph.D. (Columbia), Columbia University, New York City, U.S.A.
1902		Wells, John William, M.D., C.M. (Edin.), Springburn, Montague-street, Blackburn

Date of Election.		
1890		Wells, Sydney Russell, B.Sc., M.D. (Lond.), M.R.C.S. (Eng.), M.R.C.P. (Lond.), 24, Somerset-street, Portland-place, W.
1903		Welsford, Giles Haddon, Royal Gunpowder Factory, Waltham Abbey, Essex
1897		Welsh, John, M.R.C.S. (Eng.), L.R.C.P. (Lond.), 43, Tarvin-road, Chester
1888	Trans.	Werner, Emil Alphonse, F.I.C., 5, Church-avenue, Rathmines, Dublin
1886		Wertheimer, Julius, Prof., B.A., B.Sc. (Lond.), F.I.C., Merchant Venturers' Technical College, Bristol
1897	Trans.	West, Charles Alfred, A.R.C.S., F.I.C., 95, Oakhill-road, East Putney, S.W.
1899		West, George Hardstaff, B.Sc. (Lond.), County School, Pembroke Dock
1902		West, Joseph, 50, Poplar-grove, Fenton, Stoke-on-Trent
1898		Weston, Frank Edwin, 43, Larkhall-rise, Clapham, S.W.
1883		Wetzel, Henry Adolph, c/o Messrs. Parke, Davis & Co., P.O. Box 470, Detroit, Michigan, U.S.A.
1892		Whalley, Lawrence John de, 148, Jerningham-road, New Cross, S.E.
1893		Whalley, Sidney, B.Sc. (Lond.), 18, Nevilledale-terrace, Durham
1902		Wheeler, Edward J., Ph.D., 79, Chapel-street, Albany, N.Y., U.S.A.
1905		Wheeler, Ernest, 335, Park-road, Oldham
1894		Wheeler, Henry L., Ph.D. (Yale), The Sheffield Laboratory, New Haven, Conn., U.S.A.
1893		‖Wheeler, William Ernest, 40, Gillott-road, Edgbaston, Birmingham
1897		Wheelwright, Edwin Whitfield, B.A. (Oxon.), Ph.D. (Munich), F.I.C., Greenholme, Westfield-road, Acock's-green, near Birmingham
1879		Whitaker, Thorp, Bradford Dyers' Association, Ltd., Bradford, Yorks.
1897		White, Arthur James, 243, Albert-road, Jarrow-on-Tyne
1893		White, Henry C., Prof., University, Athens, Georgia, U.S.A.
1891		White, Henry, 245, Western-road, Crookes, Sheffield
1899		White, Henry Fox, 52, Royal York-crescent, Clifton, Bristol
1889		‖White, John Tsawoo, M.A., Pyinmana, Upper Burma, India
1905		White, John William, University College, Gower-street, W.C.
1897		White, Paul Thomas, Horton Field, West Drayton, Middlesex
1903		White, William Carter, 58 and 59, Bunhill Row, E.C.
1893		White, William Gilchrist, 13, The Crescent, Rectory-lane, Prestwich, Manchester
1885		Whitehead, Henry H., Holland House, Spring-grove, Isleworth, W.
1896		Whitehead, James, 8, West-street, Rochdale
1901		Whitehouse, Philip Lewington, Ivy House, Great Barr, Staffs.

Date of Election.		
1889		‖Whitehouse, William, Albany House, Bradmore, Wolverhampton
1904	Trans.	Whiteley, Charles Edward, 9, Abyssinia-grove, Leeds
1886	Proc.	Whiteley, Richard Lloyd, F.I.C., 5, Bagnall-street, W. Bromwich
1892		Whiteside, John Lowe, 376, St. Helen's-road, Bolton
1863		‖Whitfield, John, 113, Westborough, Scarborough
1899		Whittaker, Christopher Joseph, West Bank, Lytham
1893		Whittaker, Thomas, Ravensmere, Ansdell, Lytham
1889		Whittam, Matthew, M.A. (Cantab.), 68, St. Peter's-road, Leicester
1901		Whittle, James, 30, Bridge-street, Morpeth
1900		Wiechmann, Ferdinand Gerard, Ph.D., P.O. Box 79, Station W., Brooklyn, New York, U.S.A.
1889		Wigan, Basil P., Rhondda Valley Brewery Co., Treherbert, Pontypridd
1905		Wigginton, John Henry Becker, Kennington Cross, S.E.
1896	Proc.	Wigner, John Harrison, Ph.D. (Heidelberg), Roseneath, Carnoustie, Forfarshire
1896		Wilcox, Alfred James, Rev., 24, Statelands-road, Glossop
1891		‖Wild, John, B.Sc. (Vict.), A.I.C., Bredbury House, Bredbury, Stockport
1898		‖Wild, William Ernest, B.Sc. (Vict.), Alexander-villas, Talbot-road, Glossop
1898		Wilder, Frederick Louis, Villa Nova de Lima, Minas Geraes, Brazil
1897	Trans.	Wilderman, Meyer, Ph.D., B.Sc., Davy-Faraday Laboratory, Albemarle-street, W.
1881		Wilkes, John Potter, Nemora, The Drive, Chingford, Essex
1902	Trans.	Wilkinson, Edward John, 8, Blenheim-terrace, Leeds
1904		Wilkinson, James Alfred, M.A. (Cantab.), Transvaal Technical Institute, P.O. Box 1176, Johannesburg, South Africa
1903		Wilkinson, James Bates, M.D., C.M. (Edin.), Town Hall, Oldham
1893		Wilkinson, John, Corporation Gas Works, Halifax
1905		Wilkinson, John Wells, M.A. (Wales), 50, Woolwich-road, Belvedere, Kent
1891		Will, Wilhelm, Prof., Ph.D. (Berlin), Colonie Grunewald, Boothstrasse 32, bei Berlin, Germany
1885		Will, William Watson, 1, St. Agnes-place, Kennington Park, S.E.
1904	Proc.	Willcox, William Henry, M.D., D.P.H., B.Sc. (Lond.), F.I.C., St. Mary's Hospital, Paddington, W.
1905		Williams, Alan Herbert, 127, Roseneath-road, Urmston, Lancs.
1862	Trans.	‖Williams, C. Greville, F.R.S., Bay Cottage, Smallfields, near Horley, Surrey
1903		Williams, David John, 1, St. Agnes-place, Kennington Park, S.E
1895		Williams, Evan, Bradford-road Gas Works, Manchester
1892		Williams, John, Government Laboratory, British Guiana

Date of Election.		
1883	Proc.	Williams, Rowland, F.I.C., Hale Cote, Albert-park, Lancaster
1891		Williams, Seward W., c/o Messrs. Seabury and Johnson, 8, Brighton-avenue, East Orange, New Jersey, U.S.A.
1872		‖Williams, Thomas, Chemical Laboratory and Assay Office, 8, Victoria-street, Liverpool
1885	Trans.	‖Williams, Walter Collingwood, B.Sc. (Lond.), F.I.C., 68, Grove-street, Liverpool
1892		Williams, William, County Offices, Westgate-street, Cardiff, and 63, Plymouth-road, Penarth
1899	Proc.	Williams, William Arthur, 17, Bruntsfield-gardens, Edinburgh
1874	Trans.	‖Williams, William Carleton, B.Sc. (Vict.), F.I.C., Broomgrove, Goring-on-Thames, Reading
1898		Williamson, John Alexander, 14, Milton-avenue, Highgate, N.
1874	Trans.	‖Williamson, Robert, F.I.C., Low Walker, Newcastle-on-Tyne
1886	Trans.	Williamson, Sidney, Ph.D. (Munich), F.I.C., Faireholme, Esher, Surrey
1898		Williamson, William, 94, Hainault-road, Leytonstone, N.E.
1896		Wills, Edward Chaning, M.A. (Cantab.), East Down House, East Down, Barnstaple
1872		Wills, Joseph Lainson, 133, Midwood-street, Flatbush, Brooklyn, New York, U.S.A.
1903		Wilmore, Albert, Municipal Technical School, Colne, Lancs.
1892	Trans.	Wilsmore, N. T. M., B.Sc. (Melbourne), 126, Walm-lane, Willesden Green, N.W.
1885		Wilson, Alfred C., F.R.S.E., Borough Hall, Stockton-on-Tees
1879		‖Wilson, Charles Joseph, F.I.C., 14, Old Queen-street, Westminster, S.W.
1894		Wilson, Christopher, The Grammar School, Manchester
1883	Trans.	‖Wilson, David, M.A. (Glas.), D.Sc., Carbeth, Killearn, Glasgow
1901		‖Wilson, Duncan, Broadwater Cross, Tunbridge Wells
1899		Wilson, Frederick Robert Leyland, M.A. (Oxon.), Charterhouse, Godalming
1895		Wilson, Harry, F.I.C., 146, High-street, Southampton
1875		‖Wilson, James, M.A. (Dub.), Barrister-at-Law, 2, Essex-court, Temple ; and 15, Highbury-grange, Highbury, N.
1878		‖Wilson, James Henry, F.I.C., 6, Fenchurch-buildings, E.C.
1890		Wilson, James Mitchell, M.D., C.M. (Glasg.), D.P.H. (Cantab.), County Hall, Beverley
1901		Wilson, James Scott, M.D., C.M. (Glas.), D.P.H. (Cantab.), Bradford-street, Walsall
1895	Proc.	Wilson, John, M.Sc. (Vict.), Battersea Polytechnic, S.W.
1899		Wilson, John, 153, Buckley-street, Foots Cray, Victoria, N.S.W.
1891		Wilson, John Henry, A.I.C., Glenthorn, Northumberland-road, Coventry

Date of Election.		
1902		Wilson, Lyndon C., 31, Castle-gate, Newark-on-Trent
1900	Proc.	Wilson, Leonard Philip, Stocksfield, Church-road-north, Hanwell, W.
1871		‖Wilson, William John, c/o Dr. W. M. Watts, Shirley, Venner-road, Sydenham, S.E.
1884		Wilton, Thomas, The Gas Light and Coke Co., Beckton, North Woolwich
1893		Winder, Edward Humphreys, Wetmore, Craven Arms, R.S.O., Salop
1894		Wingate, Hamilton More, B.Sc. (Glas.), 90, Queenswood-road, Forest Hill, S.E.
1895		Wingfield, Thomas Rowland, 5, Bromwich-street, Bolton
1876		Winser, Percy James, F.I.C., Moor House, Biddulph Moor, Congleton
1898	Trans.	Witham, Ernest, B.A., B.Sc. (Lond.), The Grammar School, Rotherham
1876	Trans.	‖Witt, Otto N., Geh. Rath, Prof., Ph.D., 21, Siegmundshof, Berlin, N.W., 23., Germany
1896		Wolfenden, John Henry, B.Sc. (Lond.), 13, Pole-lane, Failsworth, Manchester
1902		Womersley, Charles Edward, 7, Tidswell-street, Heckmondwike, Yorks.
1889		Wood, Charles, Rossemount, Emm-lane, Heaton, Bradford
1860	Trans.	‖Wood, Charles Henry, F.I.C., Erica, Poole-road, Parkstone, R.S.O., Dorsetshire
1902		Wood, Frank Stanley, "Chin Chu," Heathcote-street, Newland, Hull
1898	Trans.	Wood, Thomas Barlow, M.A. (Cantab.), Gonville and Cains College, Cambridge
1903		‖Wood, William Francis John, B.Sc. (Lond.), Hazelhurst, Doncaster-road, Barnsley
1884	Proc.	Wood, William Henry, B.A. (Oxon.), La Martinière, Calcutta
1900		Woodbridge, Walter Bourne, A.C.G.I., 13, Victoria-road, Shoreham, Sussex
1871	Trans.	Woodcock, Reginald C., F.I.C., The Sanitas Co., Ltd., 636 to 642, West 55th-street, New York City, U.S.A.
1904		Woodcock, William Henry, 10, Chesson-road, W. Kensington, W.
1898		Woodhead, Samuel Allinson, B.Sc. (Dun.), F.I.C., Agricultural College, Uckfield, Sussex
1892		‖Woods, Hugh, M.D., B.Ch. (Dub.), D.P.H. (Cantab.), 26, Welbeck-street, W.
1888		Woodward, James, B.A., B.Sc. (Lond.), F.I.C., Drummond House, 31, Coventry-road, Ilford, Essex
1889		Woolf, Mortimer, Mayfield, Mortimer-road, N.W.

Date of Election.			
1903			Woolhouse, Sidney Herbert, M.A., B.Sc., A.R.C.S.I., 2, Durham-road, Lower Edmonton, N.
1889			Woosnam, Richard William, F.I.C., 1, The Chase, Warby Mount, Brentwood, Essex
1903			Worden, Edward Chancey, Clark Thread Co., Newark, New Jersey, U.S.A.
1899			Wormell, Thomas Wilson, B.Sc. (Lond.), 22, Nevill-road, Bishopston, Bristol
1884			‖Worrall, Jason Hall, F.I.C., Howsley, Chapeltown, near Sheffield
1858			‖Worsley, Phillip J., Rodney Lodge, Clifton, Bristol
1905			Wren, William James, 271, Park-road, Oldham
1898			Wrench, Charles Arthur, 95A, Southwark-street, S.E.
1904			Wright, Fred., c/o Messrs. Elliott Bros., O'Connell-street, Sydney, N.S.W.
1895			Wright, Harold E., c/o Sir B. Samuelson and Co., Ltd., Middlesbrough
1900			Wright, Herbert Edwards, M.A. (Cantab.), c/o H. Russell Wright, Esq., The Grammar School, Northwich, Cheshire
1878	Trans.		Wright, Lewis Thompson, 10, Linden-gardens, Bayswater, W.
1894			Wright, Robert, 5, Devonshire-colonnade, Buxton
1886	Trans.		Wright, William T., 11, Rundle-road, Sheffield
1864			‖Wrightson, John, Prof., College of Agriculture, Downton, Salisbury
1880			Wyborn, John Middleton, Shoulden, Farnaby-road, Bromley, Kent
1884			‖Wyley, William Fitzthomas, Wheatley-street, Coventry
1885	Trans.	C. 1892-6, S.1898-99, 1903-05, V.-P 1905-	Wynne, William Palmer, Prof., D.Sc. (Lond.), F.R.S., F.I.C., A.R.C.S., The University, and 106, Whitham-road, Sheffield
1874	Trans.		Yates, Robert, St. Hilda, Elsworthy-road, Regent's Park, N.W.
1903			Yeomans, Williams Wade, c/o Messrs. Schoellköpf, Hartford and Hanna Co., Chemical and Aniline Color Manufacturers, Buffalo, New York, U.S.A.
1886	Trans.		Yoshida, Hikorokurō, Prof., Imperial University of Kyoto, Kyoto, Japan
1885			Young, Alfred C., 53A, Algiers-road, Ladywell, S.E.
1903			Young, Andrew, M.A., B.Sc. (Edin.), Geological Department, South African College, and 1, Avenue-terrace, Cape Town, South Africa
1886			‖Young, Brougham, 2A, Sigdon-road, Dalston-rise, N.E.
1897			Young, Francis Samuel, M.A. (Oxon.), F.I.C., Nonconformist Grammar School, Bishop's Stortford

Date of Election.			
1877			‖Young, Frank W., F.R.S.E., H.M. Inspector of Science and Art Classes, 32, Buckingham-terrace, Botanic-gardens, Glasgow
1890	Trans.		‖Young, George, Ph.D., Lauraville, Bradda, Port Erin, S.O., Isle of Man
1895			Young, Henry Stow, F.I.C., c/o The Borneo Co., Ltd., Kuching, Sarawak
1894			Young, James, 12, Edge-hill, Plumstead, Kent
1877			‖Young, John Rymer, 21, Palmyra-square, Warrington
1874			Young, John, 164, Bath-street, Glasgow
1898			Young, John Henry, B.Sc. (Vict.), c/o Cassel Gold Extracting Co., Ruehill-road, Maryhill, Glasgow
1887	Trans.		Young, John William, B.A. (Lond.), B.Sc., 4, Portland-terrace, Newcastle-on-Tyne
1882	Trans.	C. 1894-8.	‖Young, Sydney, Prof., D.Sc. (Lond.), F.R.S., F.I.C., Trinity College, Dublin
1902			Young, Thomas A., 318, Cheetham-hill-road, Manchester
1873			‖Young, William Charles, F.I.C., Normanhurst, High-road, Romford ; and Chemical Laboratory, 19/20, Aldgate, E.C.

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